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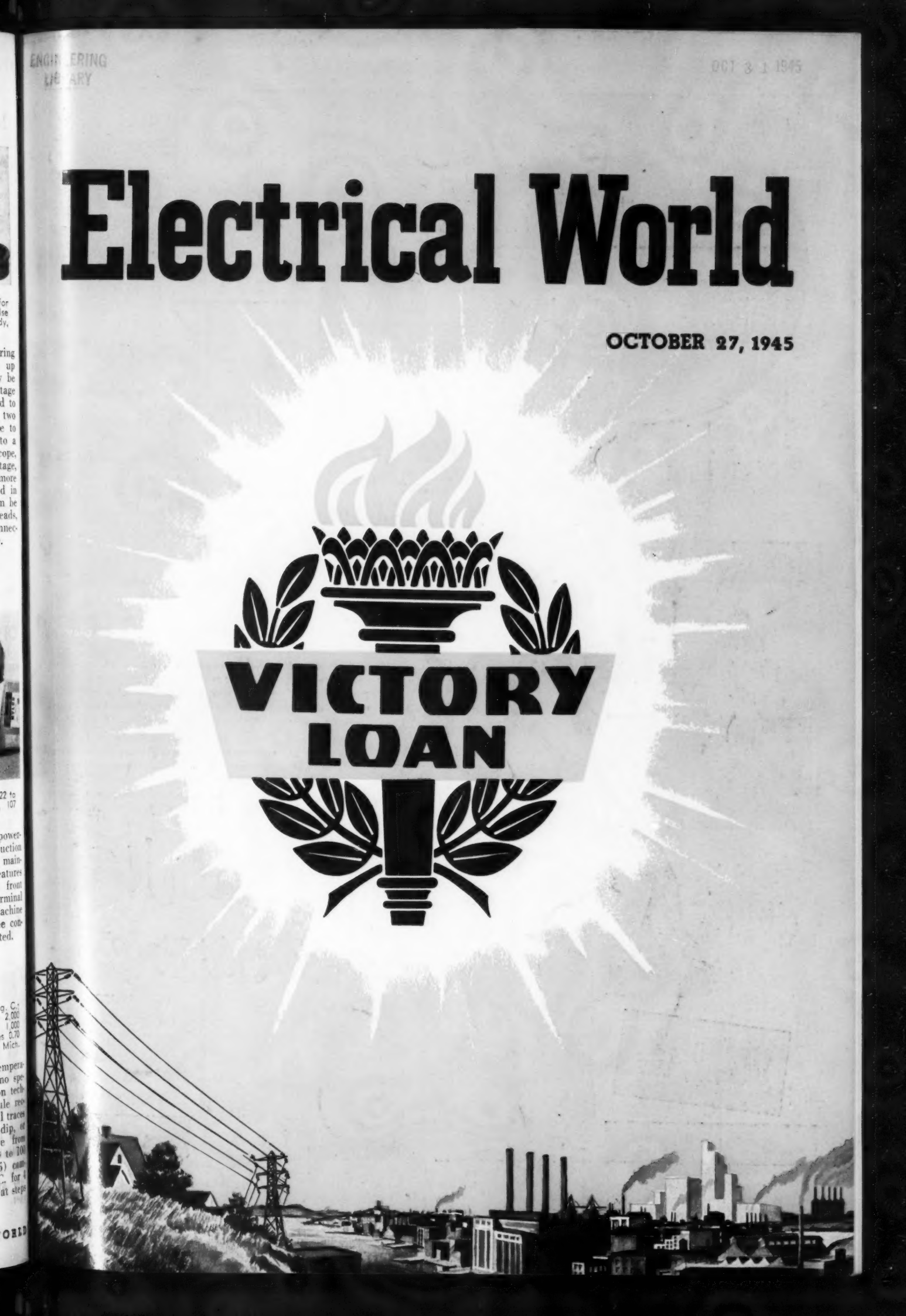

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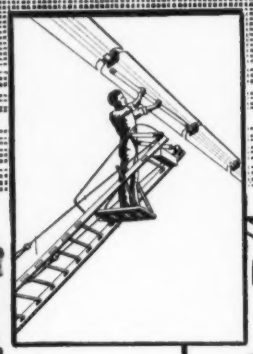

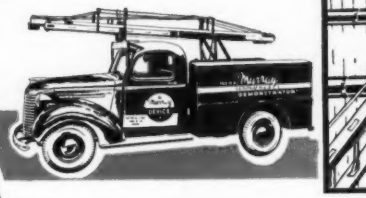

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Electrical World

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October 27, 1945 — Vol. 124, No. 17

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ELECTRICAL WORLD

Published weekly. Price 25 cents a copy. Publication office 99-129 N. Broadway, Albany 1, N. Y. Allow at least ten days for change of address. Address communications about subscriptions to Director of Circulation, Electrical World, 330 West 42nd Street, New York 18, N. Y.

RETURN POSTAGE GUARANTEED

Subscription rates: In the United States, Mexico, Central and South American countries, $5 a year, $8 for two years, $10 for three years. Canada $6 for one year, $10 for two years, $12 for three years (Canadian money at par). Great Britain and British possessions, 60 shillings for one year, 120 shillings for three years. All other countries $8 for one year, $18 for three years. Please indicate position and company connection on all subscription orders. Entered as second class matter November 16, 1936, at Post Office at Albany, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

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Branch Offices: 520 North Michigan Avenue, Chicago 11, Ill.; 68 Post Street, San Francisco 4; Aldwych House, Aldwych, London, W.C. 2; Atlanta, Ga.; Boston, Cleveland, Detroit, Los Angeles, Philadelphia, Pittsburgh, St. Louis, Washington.

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JAMES H. McGRAW
Founder and Honorary Chairman

Publication Office
99-129 North Broadway, Albany 1, N. Y.

Editorial and Executive Offices
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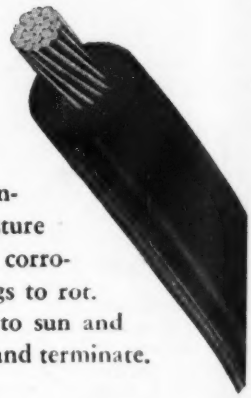

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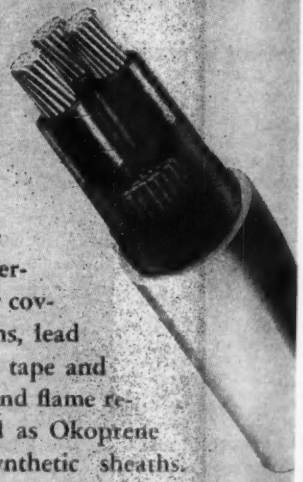

Okonite varnished cambric insulated wires and cables for operations up to 28,000 volts comprise a complete line for all types of power circuits. A wide range of outer protective coverings is available. These outer coverings include fibrous sheaths, lead sheaths, interlocked metallic tape and armor wire, asbestos braid, and flame retardant cotton braid as well as Okoprene and other non-metallic synthetic sheaths.

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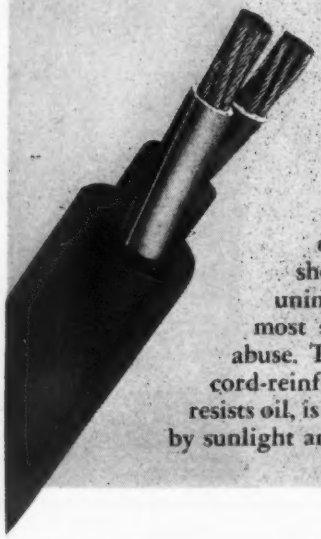

Extra flexible stranding is standard in all Okocord portable cords and cables designed for leads on electrical welding equipment, tools, portable equipment, magnet cranes, dredges and electric shovels. Designed to transmit uninterrupted power under the most severe conditions of external abuse. This cable is furnished with a cord-reinforced Okoprene jacket that resists oil, is non-flammable and unaffected by sunlight and exposure.

Engineers in all branches of industry are invited to bring their problems of electrical transmission and distribution to Okonite engineers. By combining their experiences, the correct selection of wires and cables is made easy, low maintenance and long life assured. The Okonite Company, Passaic, New Jersey.

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insulated wires and cables

4182

Electrical World
OCTOBER 27, 1945

The Price Problem

WHEN AN IRRESISTIBLE FORCE meets an immovable object, something explosive generally happens. On the other hand, if the object can give a little, the force can be absorbed and equilibrium be established in a comparatively short time. That is nature's law and it can be applied to economics.

A situation of this nature is being built up today with respect to prices and wages. The irresistible force of higher compensation for labor is meeting head on the immovable force of ceiling prices and unless there is more than a little price elasticity we can expect some sort of economic and perhaps social outburst.

Inflation control measures are not universally popular, even under a war economy when it is easiest to hold the line in all directions. They are much less popular in a peace-time economy, though it be a period of reconversion, when for political or other reasons it is no longer expedient to hold the line at all important places. Likewise, manufacturers and distributors can not operate under rigid ceilings when they lose control over a substantial part of their costs.

If labor represents but a small part of the cost of a product then even large wage increases can be absorbed with little or no price adjustment but when, as in the production of electrical equipment and appliances, the labor cost component is a very substantial element, it isn't reasonable to expect the manufacturers and the trade to absorb much, if any, wage increases.

While the ends may at times justify the means, artificial restraints like price control can, if too rigidly applied, produce effects that are more detrimental to the over-all economy than the mischief that might have occurred without the control. For instance, this is budget time for next year's utility construction expenditures. Under rigid price control, manufacturers will be unwilling to quote firm prices for other than short-time deliveries on many products, with the result that cost estimates may therefore very likely be high for protection. It would not be unreasonable to expect, under such conditions, that some projects that were not too pressing might be deferred until the price picture was clarified.

Likewise, too rigid price controls can be expected to delay sales schedules on the theory that it is better to wait until a profit can be made before unloading too large a volume of merchandise. Right now this process is going on, pending a satisfactory clarification of the ceiling issue.

In some of the raw materials, like steel, a wage increase without a corresponding price correction might very easily result in a drop in production in some of the low-profit standard lines. In that event, the consequence would be reflected in further unemployment in user shops.

In other words, there are natural economic forces at work today and to interfere with them through artificial restraints beyond the point of assuring a fair distribution of materials in extremely short supply might delay spending and full employment.

In taking this position we are not advocating inflation, for we believe that competition will keep prices in check. Under a freer play of economic forces stability to purchasing power can come faster and markets can then be expanded. People can make plans and commitments with full knowledge of what they are doing.

A Procedure for Calculating Distribution Voltage Drop

Compilation of electrical characteristics for conductors of stranded and solid copper, ACSR, and Copperweld-copper—Forms for voltage drop determinations on both primary and secondary circuits—Regulated primary voltage predicted by load currents

Compiled by Electrical Distribution Engineering Dept., Consumers Power Co., Jackson, Mich.

STEPS ARE OUTLINED for a method to determine voltage drop on a distribution system. In the development of this method, engineers in the electrical distribution department of Consumers Power Co. assembled data on conductor characteristics, devised forms for voltage computations, and graphs for visualizing primary circuit operation.

Accompanying Table 1 of conductor characteristics is a compilation of data from a number of conductor tables of several manufacturers. These data are assembled into a convenient form for use in making voltage drop determinations on both primary and secondary circuits with various equivalent spacings listed in Table 2 and for configurations in Fig. 1 where equivalent spacing is equal to the cube root of the product of the distances between the conductors, thus $\sqrt[3]{abc}$

Primary Voltage Study

Calculation of voltage conditions on primary circuits has been greatly facilitated by the use of the calculating form shown by Fig. 2 which carries the computations through a simple step-by-step procedure. This form is followed in making all primary voltage studies on the system.

Steps involved in the use of the form for primary voltage calculations are as follows:

1. Obtain maximum loading on the circuit to be studied from graphic meters, log sheets or by special test, converting current values to kva.

2. Obtain total connected transformer kva. on the circuit by actual count from the various record maps.

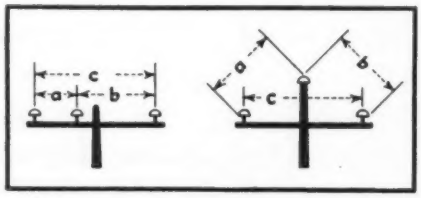


FIG. 1—Conductor spacings for Table 2

3. Calculate the average demand factor of the circuit.

4. Under respective columns:

A. Divide the circuit into sections and identify the end of each line section. Several transformers may be included in one line section.

B. Wire size in line section.

C. Distance—length of section in miles.

D. Drop per wire per ampere for the appropriate power factor from accompanying curves of drop per ampere per mile versus power factor. The curves (Fig. 3) provide data sufficiently accurate for rough calculations. For everyday use the same data arranged in tables is more convenient and accurate.

E. Tabulate the product of Columns C and D divided by line kilovolts. The line kilovolts are assumed constant over the circuit. Some error is introduced by this assumption but if the voltage chosen is the nominal distribution circuit voltage errors will nearly add to zero.

F. Transformer kva. connected in section under consideration.

G. Demand factor obtained above.

H, J & K. Complete as indicated on the form.

Additional columns are provided so that the primary drop can be reduced to a secondary base for easy tabulation and comparison. Additional columns are also provided for added loads, load changes, etc.

Some circuits have a large concentrated load of known maximum demand. Such a load should be subtracted from the active circuit load before the calculation of the circuit average demand factor is made. Such known concentrated demands are then added again in the proper place on the calculation sheet.

Once a circuit calculation has been made, the effect on circuit voltage of load changes or additional loads may be quickly determined. The columns of the form are arranged to simplify and make easy the determination of the effect of load increases, illustrated on the example by calculations for a 10 percent circuit increase. Resulting voltage drops and existing voltages are shown in the last two columns on the right hand side of the page.

"Voltage Profile"

To aid in visualizing circuit voltage drops, a graph or "voltage profile" of the circuit may be made as shown in Fig. 4. Such profiles are easy to construct, and present a clear cut picture of circuit conditions.

This method of calculating voltage drops has been found superior to other somewhat similar methods for several reasons.

1. The characteristic drop figure for each conductor is independent of circuit voltage.

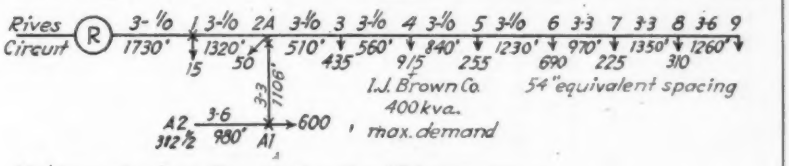
2. The formula $(R \cos \theta + X \sin \theta)$ used for calculating constants for new

FORM 260—SM—11-41

CONSUMERS POWER COMPANY
ELECTRICAL DISTRIBUTION ENGINEERING DEPARTMENT

CALCULATION SHEET

SHEET
DIVISION Kalem SUBSTATION Greenwood MADE BY J.S.F.
SUBJECT Primary voltage study - Rives circuit DATE 11/24/41
CIRCUIT DIAGRAM: POWER FACTOR 80% LINE KV. 4.80 CH'KD BY H.T.D.
DATE 11/24/41



Maximum load reading on circuit = 274 amperes or
$\sqrt{3} \times 4.8 \times 274$ = 2279 kva.
known maximum demand of primary metered customer = 400 kva.
Circuit demand factor = $\frac{2279 - 400}{4047\frac{1}{2}} = 0.464$

SECTION NO.	CIRCUIT DATA: FROM TO (A)	CONDUCTOR SIZE (B)	DISTANCE (C)	DROP FACTOR: VOLTS DROP/WIRE/AMP. (D)	VOLTS DROP/KVA. C×D/LINE KV (E)	LINE SECTION DEMAND: TRANSF. KVA. CONN. IN LINE (F)	DEMAND FACTOR (G)	DEMAND KVA/LINE SECTION (H)	TOTAL DEMAND KVA. FED THRU LINE (J)	LINE SECTION DROP: LINE VOLTAGE DROP J×E (K)	40/1-120-volt secondary base Drop (L)	Voltage (M)	Assume a 10% load increase L1×L (N)	(O)
	Substation (determined from regulator graph)											129.44		130.18
1	Quincy & Harris	3-1/0	0.328	.881	.0603	15	464	7	2279	137.6	3.44	126.00	3.78	126.40
2A	" & Pearl	"	0.250	"	.0459	50	"	+457 23	2272	104.3	2.61	123.39	2.87	123.53
3	Bay & Lawson	"	0.096	"	.0177	435	"	202	1792	31.7	0.79	122.60	0.87	122.66
4	Creek & Winfield	"	0.106	"	.0195	9/5	"	+400 425	1590	31.0	0.78	121.82	0.86	121.80
9	Morrel & Saw	3-6	0.239	2.239	.1113	170	"	79	79	17.8	0.22	119.53	0.24	119.28
												123.39		123.53
A1	Pearl & Jones	3-3	0.208	1.342	.0585	600	"	278	456	26.8	0.67	122.12	0.74	122.49
A2	15th & "	3-6	0.185	2.239	.0866	383½	"	178	178	15.4	0.38	122.34	0.42	122.37

FIG. 2—Calculation sheet completed for sample primary voltage study

or odd sized conductors is one of the most familiar.

3. In designing the form, special effort was made to maintain the tabulated values in units made common by long use. (The value of the use of well-known terms in making any routine easy to understand, and in reducing errors, is often overlooked.)

Regulator Operation

Operation of distribution circuit regulators may be readily determined by the use of a simple straight line graph made up from data on records of regulator settings kept by most companies for each circuit regulator.

Using load currents as abcissae and primary voltage taken on a 120-volt base as ordinates, a chart (Fig. 5) is made by drawing a straight line through the two data points given on the regulator setting record.

(Here again, as in other places in this discussion the procedure contains approximations which do not depart from the exact results sufficiently to disturb the desired accuracy.)

1. Zero current—no load voltage (at regulator and along the circuit).

2. Full load current—full load voltage (at the regulator).

The available primary regulated voltage at the substation, corresponding to any existing maximum load on the specific circuit that may be under consideration, is easily determined from the curve within the capacity of the regulator and the available unregulated bus voltage.

The sample graph was constructed for a no-load voltage setting of 122 volts and a setting of 128.5 volts for a circuit load of 240 amp. Regulated primary voltage at the substation for currents of 274 amp. and 301.4 amp. are determined as shown.

Combining the information which this graph gives with a carefully made primary voltage calculation form (Fig. 2), provides all the necessary tools for determining the effect of load variations on a distribution circuit.

Secondary Voltage Study

To calculate secondary loads and voltage drops to any degree of accuracy it is necessary to estimate customer's loads and demand as well as to have the necessary circuit maps. The accuracy of secondary voltage drop calculations is governed largely by the accuracy of the assumed electric range load which is used in the calculations.

The most accurate method of determining electric range load would be a house to house survey of the area concerned but this usually requires more time and effort than is available.

An alternate method which has been found fairly accurate, involves checking meter readers' books of the customers involved. From actual checks made in carefully chosen "typical" areas, it has been found that if the customer's kilowatt-hour monthly consumption is above the following values, it may be safely assumed that the customer has an electric range, or equivalent load demand.

Residential Area	*Kw.-Hr.*
Low Demand	150
Med. Demand	200
High Demand	250

Whether an area is a low, medium or high demand area is based on the engineer's judgment of the neighborhood served by the particular transformer. In most cases, the medium demand area figure is used. These

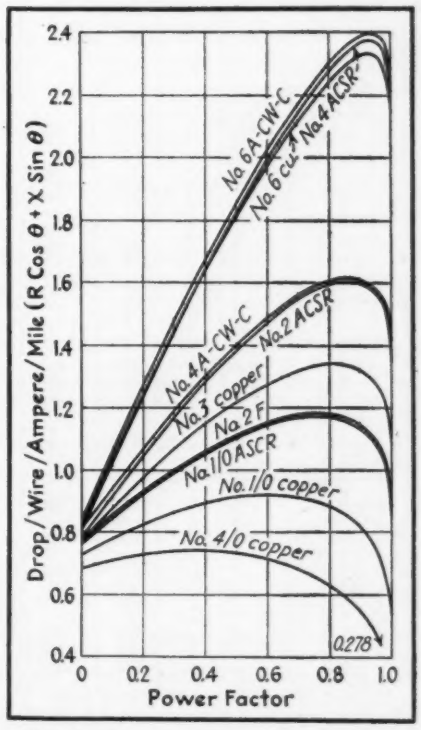
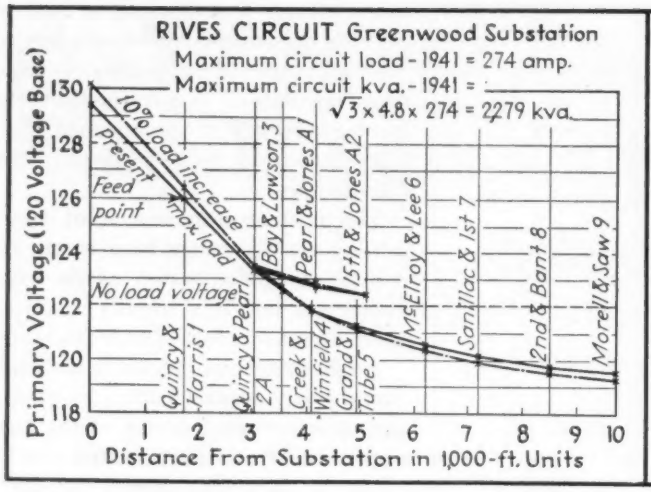


FIG. 3—Curve yields voltage drop per ampere per wire per mile for various conductors with 54-in. equivalent line spacing, calculated from Table I. Curves provide quick solution to equation (R cos Θ + X sin Θ)


RIVES CIRCUIT Greenwood Substation
Maximum circuit load - 1941 = 274 amp.
Maximum circuit kva. - 1941 =
√3 x 4.8 x 274 = 2279 kva.
10% load increase
Present max. load
Feed point
No load voltage
Quincy & Harris 1
Quincy & Pearl 2A
Bay & Lawson 3
Creek & Winfield 4
Pearl & Jones A1
Grand & Tube 5
15th & Jones A2
McElroy & Lee 6
Sanillac & 1st 7
2nd & Bant 8
Morell & Saw 9
Primary Voltage (120 Voltage Base)
Distance From Substation in 1,000-ft. Units

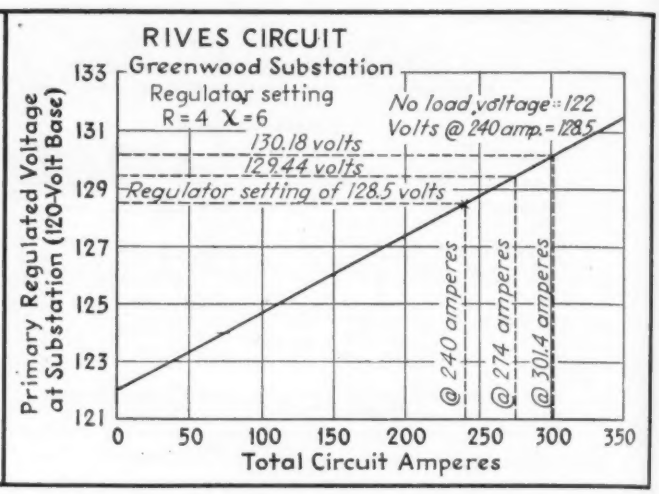


FIG. 4 and 5—Voltage profile for sample circuit (left) gives ready visualization of existing and projected circuit conditions. Straight line graph (right) constructed from regulator setting data gives primary regulated voltage (at substation) for vales of circuit amperes

basic values may be altered to fit particular existing conditions.

Once the number of lighting and range customers are determined, load carried over each secondary span can be determined by reference to the attached diversified demand scales. No diversity is assumed between lighting and range loads since it has been our experience that refrigeration load will more than compensate for any error in this assumption.

Calculations of voltage drop for each secondary span of a circuit are exemplified in Fig. 6 and are executed on the same form previously described for primary voltage studies. Data on the circuit is entered in the appropriate columns as follows:

A. Span identification.

B. Conductor size.

C. Span length in thousand feet

D. Voltage drop per wire per ampere per thousand feet.

Table I—Conductor Characteristics

Wire Size	Number of Strands	Res., Ohms per Mile, 25 deg.C.	60 Cycle Reactance per Conductor, ohms per mile — Equivalent Spacing, inches											
			8	10	12	16	29	34	38	48	54	56	59	67	88
ACSR Conductors Based on 600 Amp. per Sq. In.															
4/0	6 x 1	0.464	.495	.522	.544	.579	.651	.670	.684	.712	.726	.731	.737	.752	.786
3/0	6 x 1	0.579	.505	.532	.554	.589	.661	.680	.694	.722	.736	.741	.747	.762	.796
2/0	6 x 1	0.718	.515	.542	.564	.599	.671	.690	.705	.733	.747	.752	.757	.773	.806
1/0	6 x 1	0.893	.526	.553	.575	.610	.682	.701	.715	.743	.757	.762	.768	.783	.817
1	6 x 1	1.12	.537	.564	.586	.621	.693	.712	.727	.754	.768	.773	.779	.795	.828
2	6 x 1	1.41	.548	.575	.597	.632	.704	.723	.737	.765	.779	.784	.790	.805	.839
4	6 x 1	2.24	.569	.596	.618	.653	.725	.744	.759	.786	.800	.805	.811	.827	.860
6	6 x 1	3.56	.597	.624	.646	.681	.753	.772	.786	.814	.828	.833	.839	.854	.888
Copperweld-Copper Conductors															
2F	6 x 1	0.905	.526	.553	.575	.610	.682	.702	.715	.744	.758	.762	.769	.784	.817
4A	2 x 1	1.40	.571	.598	.620	.655	.727	.746	.760	.788	.802	.807	.813	.829	.862
6A	2 x 1	2.25	.599	.626	.648	.683	.755	.774	.788	.816	.831	.835	.841	.857	.890
Stranded Copper Conductors															
500 Mcm.	19	0.120	.396	.423	.445	.480	.552	.571	.585	.613	.627	.632	.638	.653	.687
350 Mcm.	19	0.169	.417	.444	.466	.501	.573	.593	.606	.635	.049	.653	.660	.675	.708
4/0	7	0.278	.454	.481	.504	.538	.611	.630	.643	.672	.686	.690	.697	.712	.745
3/0	7	0.350	.468	.496	.518	.553	.625	.644	.657	.686	.700	.705	.711	.726	.759
2/0	7	0.440	.482	.510	.532	.567	.639	.658	.672	.700	.714	.719	.725	.740	.773
1/0	7	0.555	.497	.524	.546	.581	.653	.672	.686	.714	.728	.733	.739	.754	.787
1	3	0.692	.508	.535	.557	.592	.664	.683	.697	.725	.739	.744	.750	.766	.799
2	3	0.873	.522	.549	.571	.606	.678	.697	.711	.739	.753	.758	.764	.780	.813
3	3	1.101	.536	.563	.585	.620	.692	.711	.725	.753	.768	.772	.778	.794	.827
Solid Copper Conductors															
3	1	1.090	.545	.573	.595	.630	.702	.721	.735	.763	.777	.782	.788	.803	.836
4	1	1.374	.559	.587	.609	.644	.716	.735	.749	.777	.791	.796	.802	.817	.850
6	1	2.185	.588	.615	.637	.672	.744	.763	.777	.805	.819	.824	.830	.846	.879
8	1	3.474	.616	.643	.665	.700	.772	.791	.805	.833	.847	.852	.858	.874	.907
10	1	5.526	.644	.671	.693	.728	.800	.819	.833	.861	.875	.880	.886	.902	.935

Table II

Standard Equivalent Spacings, inches (See Fig. 1)

	3 Phase	1 Phase
4 Pin Flat	34	59
4 Pin Pole Top	38	..
6 Pin Flat	54	88
6 Pin Pole Top	56	..
8 Pin Flat	67	..
8-in. Rack	10	8 or 16

Table III

Voltage Drop Per Wire Per Ampere Per 1,000 Ft. 95 Percent P. F. (Lagging)

Copper Wire Size	Spacing 8 in.	Spacing 16 in.
Stranded		
500 Mcm	0.045	0.050
350 Mcm	0.055	0.060
4/0	0.077	0.082
3/0	0.091	0.096
2/0	0.108	0.113
1/0	0.129	0.134
1	0.155	0.159
2	0.188	0.193
3	0.230	0.235
Solid		
3	0.228	0.233
4	0.280	0.285
6	0.428	0.433
8	0.661	0.666
10	1.032	1.037

(Note: A 95 percent power factor is normally assumed for residential secondary.)

E. Tabulate the product of Column C and D divided by the line kv. (0.240 for three-wire secondary.)

F. Number of lighting and range customers as estimated from the meter route books connected at each secondary point.

H. Demand of lighting and range customers obtained from customer demand curves.

J & K Complete as indicated on form.

The voltage drop through the transformer is determined from the total load carried by the transformer and the percent transformer regulation obtained from any one of the numerous tabulations available. A sample transformer regulation calculation based on transformer characteristics (percent *IR* and percent *IX* and load characteristics (kva. and power factor) is included on the secondary voltage calculation sheet.

Brief study of the sample calculations will show very clearly the desirability of short secondaries and more 10 and 15-kva. transformers. In this sample case the voltage drop will be beyond desirable limits if more secondary is installed to load up the 25-kva. transformer.

FORM 2A7—SM—11-41

CONSUMERS POWER COMPANY
ELECTRICAL DISTRIBUTION ENGINEERING DEPARTMENT

CALCULATION SHEET

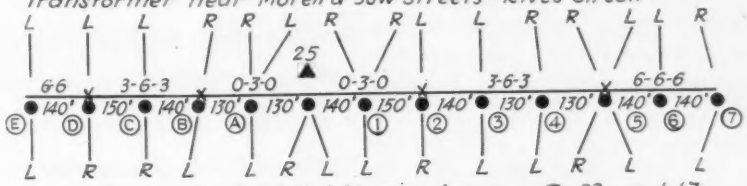
SHEET ____ MADE BY J.S.F. DATE 11/24/41 CH'KD BY H.T.D. DATE 11/25/41

DIVISION Kalem SUBSTATION Greenwood

SUBJECT Secondary Voltage Study

CIRCUIT DIAGRAM: POWER FACTOR 95% LINE KV. 12/24

Transformer near Morell & Sow Streets - Rives Circuit



Transformer load - 29 lighting customers @ .23 = 6.67
12 ranges @ 1.28 = 15.36
22.03

SECTION NO.	FROM / TO	CIRCUIT DATA: CONDUCTOR SIZE	CIRCUIT DATA: DISTANCE 1000'	DROP FACTOR: VOLTS DROP/WIRE/AMP.	DROP FACTOR: VOLTS DROP/KVA, C x D / LINE KV.	LINE SECTION DEMAND: Cust. TRANSF. KVA. CONN. IN LINE	LINE SECTION DEMAND: DEMAND FACTORS	LINE SECTION DEMAND: DEMAND KVA/LINE SECTION	LINE SECTION DEMAND: TOTAL DEMAND KVA. FED THRU LINE	LINE SECTION DROP: LINE VOLTAGE DROP J x E	LINE SECTION DROP: 2/1 120-volt secondary base Volt-Drop age	LINE SECTION DROP: Volt-		
	A	B	C	D	E	F	G	H	J	K	L	M	N	O
	Primary of transformer (from primary study)											119.53		
	Transformer characteristics, %IR = 1.65, %IX = 2.75													
	Transformer drop			1.65 x .95 + 2.75 x .312	100			22.03 / 25.00	x 120 =		2.56	116.97		
1		0-3-0	.14	2x.134	.156	1 6 L 7 R		4.16 10.64	14.80	2.30	1.15	115.82		
2		0-3-0	.15	"	.167	1 3 L 5 R		3.64 6.75	12.39	2.07	1.03	114.79		
7		6-6-6	.14	2x.433	.505	2 L 1 R		1.02 3.60	4.62	2.33	1.17	101.21		
A		0-3-0	.13	2x.134	.145	11 L 4 R		3.14 2.00	11.19	1.62	0.81	116.16		
E		6.6	.14	2x.433	1.01	2 L 0 R		1.02 0	1.02	—	1.03	112.52		

FIG. 6—Secondary voltage calculations for sample circuit

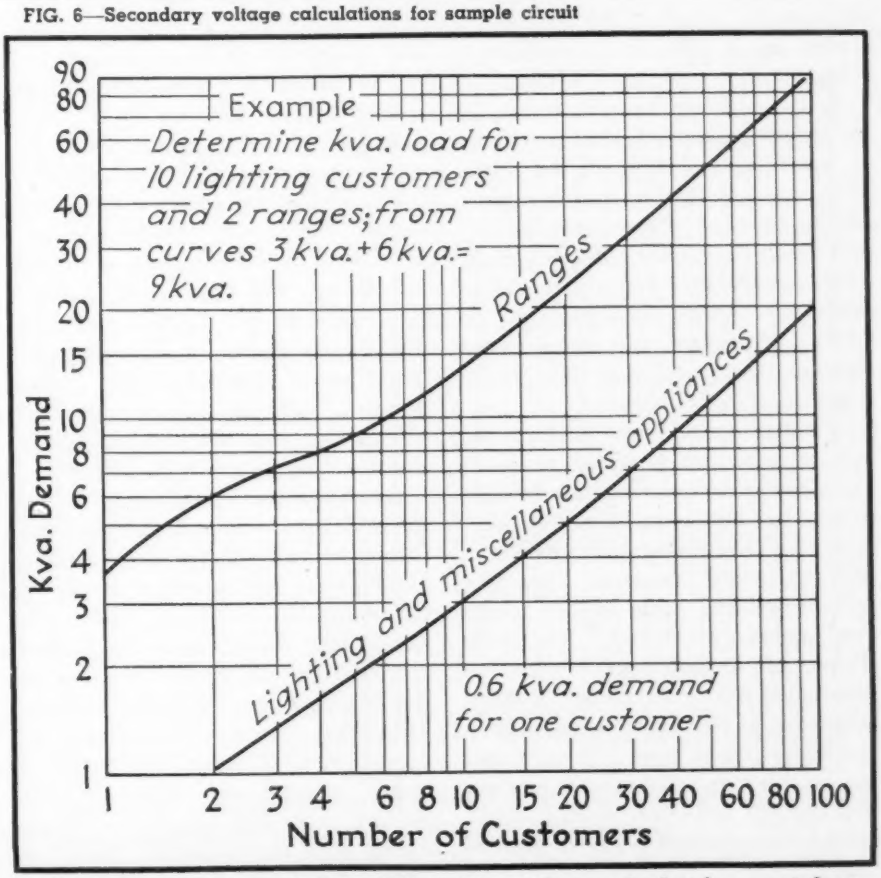


FIG. 7—Diversified demand scale yields lighting and range load to be expected on typical circuit supplying specified number of customers

Cyclic Flicker of Fluorescent Lamps*

Small energy storage makes phosphors noticeably responsive to pulsations around 15 per second, particularly when inductively ballasted —Superior to incandescent lamp when ballasted inductive-capacitively—Flicker considerations call for adequate ballasting

W. R. WEISE, The Cincinnati Gas & Electric Co., Cincinnati, Ohio

TECHNICAL CURVES and data on fluorescent lamps for static conditions show that the lumen output is less affected by voltage change than is the case with incandescent lamps. This might be taken as indicating that fluorescent lamps are also less affected by cyclic voltage variations. However, practically no energy is stored in electric discharge lamps, and the light output drops instantly with changes in voltage. Fluorescent phosphors do possess some phosphorescence but nothing like the energy stored in a 100-watt incandescent filament.

Tests which we have made are by no means exhaustive, but they may be taken as indicative of the possibility of cyclic flicker trouble with a combination of fluorescent lighting and welding, or other pulsating loads. This preliminary investigation was made after use of data published in 1937, pertaining to incandescent lighting, failed to give the results expected.

A rearrangement was made in the primary distribution system to alleviate a cyclic flicker condition brought about by the installation of electronically controlled seamwelders of 180-kva. rated capacity, operating with a welding cycle of two cycles "on" and two cycles "off." The cyclic flicker of incandescent lamps was eliminated but cyclic flicker of fluorescent lamps persisted. Apparently at the higher frequencies (15 cycles per sec. in this case), the greater filament heat content and lower speed function of the incandescent filament resulted in the better performance of the incandescent lamp under cyclic flicker conditions.

Tests of Fluorescent Lamps

Cyclic flicker tests (see figure) were made on a 40-watt two-lamp fixture, a 20-watt low power factor fixture and a 20-watt high power factor unit. Tests were also made on a 100-watt and a 200-watt incandescent lamp for reference. The illumination on the test screen was kept at 20 foot-candles and the frequency and magnitude of flicker varied.

The two-lamp fixture used in the tests operated with the split phase principle, one lamp ballasted with inductive reactance and the other with inductive and capacitive reactance in series. The current through the lagging lamp lags the impressed voltage by 60 deg. and the current through the leading lamp leads the voltage by 60 deg., to produce a 120-volt phase displacement between the two lamps, thereby reducing the stroboscopic effect. The resultant power factor for the two-lamp fixture is 95 percent.

As shown the leading lamp is less affected by cyclic voltage variation than the lagging lamp. For example, at 12 cycles per second a 1-volt cyclic variation produces about the same cyclic flicker from the leading lamp as 0.6 volt cyclic variation on the lagging lamp at rated voltage. This difference in performance is indicated by the characteristic curves of lumen output versus voltage for the leading and lagging lamps. These curves give the following change in lumens for a plus or minus 10 percent change in voltage; for the leading lamp from 92 percent lumens at 10 percent under-voltage to 108 percent lumens at 10 percent over-voltage, and for the lagging lamp from 80 percent lumens at 10 percent under-voltage to 120 percent lumens at 10 percent over-voltage. The total spread in lumen output is 16 points for the leading lamp and 40 points for the lagging lamp. These can be compared to 60 points for the incandescent lamp for the same conditions.

The tests also disclosed that the 20-watt low-power factor lamp and the 20-watt high power factor lamp possessed the same flicker characteristics as the lagging lamp of the two-lamp fixture and the curves for these other types were omitted for clarity.

Abnormal Voltages

Data on cyclic flicker were also obtained at various frequencies for over-voltage and under-voltage operation. It was noted that low voltage materially affected the flicker characteristics. At 10 percent under-voltage the fluorescent lamp was more susceptible to cyclic flicker, particularly the lagging lamp or the usual inductively ballasted lamp; shown in test results for 108 and for 118 volts.

When the inductively ballasted fluorescent lamp is operated at 108 volts, perceptible flicker occurs at about 0.25 volt less voltage variation than when operation is at 118 volts. For example, at a frequency of ten cycles per second perceptible flicker begins at about 0.4 volt variation, if operation is at 108 volts, but at 118 volts perceptible flicker does not begin until the voltage variation is about 0.65 volt. A comparison between the

* Paper presented at recent meeting of EEI Transmission and Distribution Committee.

lagging lamp operating at 108 volts and a 100-watt incandescent lamp at 15 cycles per second indicates that perceptible flicker from the fluorescent lamp begins at about 0.65 volt variation but does not start on the incandescent lamp until the voltage variation is about 1.2 volts.

Conclusions and Discussion

These tests indicate the following conclusions:

1. The inductive-capacitive ballast as used in the leading lamp of the two-lamp ballast provides a source of illumination that is less affected by cyclic flicker than a 100-watt incandescent lamp and its use should be encouraged. This type of ballast is over-corrected for power factor and will help supply kilovars for the uncorrected appliance loads connected to the secondary mains.

2. The usual inductively-ballasted fluorescent lamp produces objectionable cyclic flicker, particularly in the higher ranges of frequencies from 10 to 15 cycles where the incandescent lamp is superior because of its lower speed function.

3. At 10 percent below normal voltage the fluorescent lamp is noticeably more susceptible to cyclic flicker than at rated voltage.

4. Cyclic flicker problems will increase if the lower cost types of fluorescent fixtures using inductive ballasts are used for residential lighting. Air conditioners, deep freeze refrigerators, household refrigerators, and electronically controlled seam welders are all potential sources of cyclic flicker and the type of residential lighting must be such that it is not susceptible to cyclic flicker.

Precautions

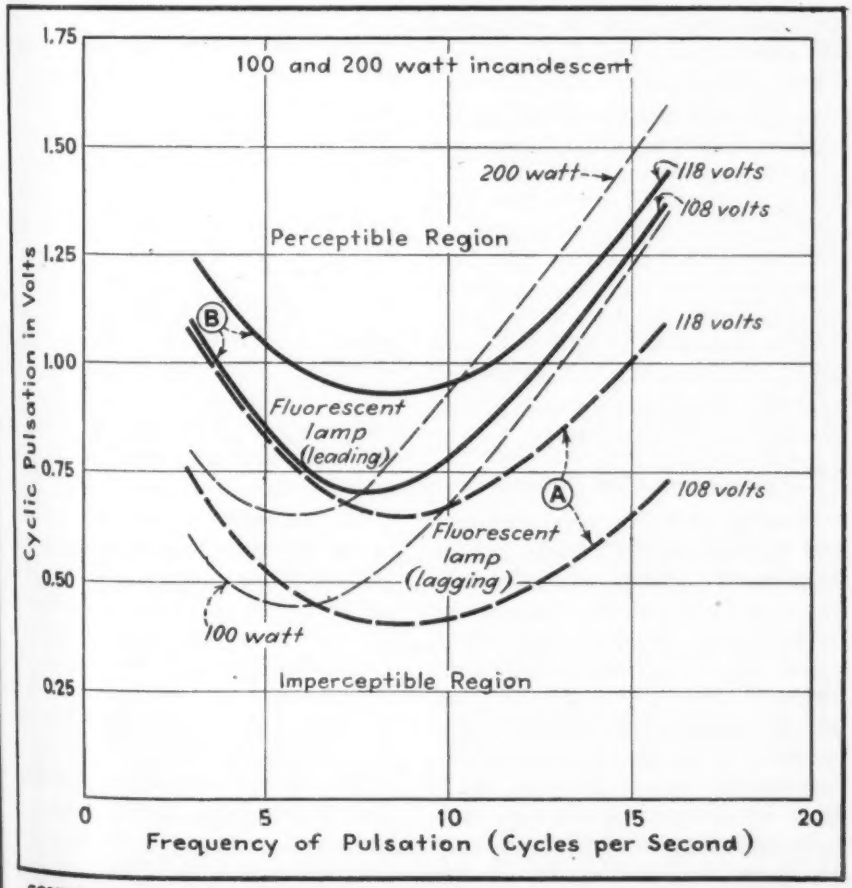
As flicker problems become more prevalent, it will become necessary to know more about the cyclic voltage variation on both primary feeders and secondary systems. In using the curves for perceptible flicker calculations, the voltage disturbance produced by the changes in current or current and power factor during the load cycle of an electrical device must be determined and the calculations must take into account any cyclic voltage variation that already exists on the system under study. For example, if calculations indicate that a new load to be added will produce a cyclic voltage variation of say 0.4 percent at a frequency of six per second for all customers on a particular feeder or system, this condition might be accepted because the resulting flicker is imperceptible. If, however, a cyclic voltage variation of 0.3 percent already exists on this feeder or a number of secondaries on the feeder, the resultant cyclic voltage variation can produce objectionable flicker complaints.

Similarly, in correcting a cyclic flicker condition, it is necessary to determine what portion of the total exists on the premises, the secondary, the primary feeder, or perhaps the substation bus.

At Control Points

Obviously the allowable cyclic voltage variation varies at different points on the electric system and it is becoming necessary to determine this value of voltage as well as the normal static voltage condition, as recorded by the graphic voltmeters used for voltage control. Along with routine voltage charts obtained for records and engineering study, records of cyclic voltage variation at the various control points are necessary.

The use of combination power and light feeders is desirable from an economic standpoint but conditions must be controlled so that flicker problems are not created. Also, when rearrangements are made to mitigate flicker conditions it is not economical to reduce the flicker below the imperceptible value. The distribution engineer must therefore recognize the necessity for first hand knowledge of flicker conditions and cyclic voltage variation as a necessary part of all voltage surveys.



COMPARATIVE CYCLIC FLICKER characteristics of fluorescent and incandescent lamps. a. Fluorescent with inductive reactance ballast, b. Fluorescent with inductive and capacitive reactance in series

Low Voltages Obsolete?

In making a case for adoption of 240 volts (rather than 220, 230 or 250) as the standard for British consumers, J. M. Donaldson, director of Northwest Power Co., in a recent issue of *Electrical Review*, said that "when complaints are made about different voltages in different districts they almost always relate to the 100-volt range." He added that "there can be no question that these lower voltages will eventually have to go."

Effects of Harmonics on Watthour Meter Accuracy

Unless degree of wave distortion is unusually large modern watthour meters perform satisfactorily—Flux interactions discussed—For extreme cases calibration should be done with indicating instruments

PROFESSORS M. A. FAUCETT and C. A. KEENER, University of Illinois, Urbana

A WATTHOUR METER is designed and is adjusted, in practice, to operate in circuits of standard frequency and voltage in which little wave distortion exists. These conditions are usually closely approximated and the errors in energy measurement due to the approximations are negligible. However, the increasing industrial applications of electronic and high frequency equipment causing harmonic distortion in the load current has caused concern regarding the performance of the watthour meters used to measure the energy required.

Not all electronic equipment will introduce distortion of current wave form but such devices as rectifiers, inverters, frequency changers, welders (electronically controlled), speed control equipment for small motors, etc., often are sources of appreciable distortion. Transformers and other ordinary power equipment requiring alternating magnetizing currents may cause appreciable current harmonics when operated at high flux density.

As a measure of the distortion of a wave of current or voltage from the sine wave form, "distortion factor" has been defined as "the ratio of the effective value of the residue after the elimination of the fundamental to the effective value of the original wave." (A. S. A. C-42-1932 Section 10, 95, 430.)

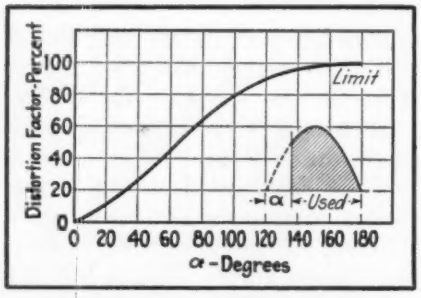


FIG. 1—Progressive values of distortion factor for part-wave utilization (e.g. electronically controlled welding)

Example—A current of 10 amp. in which the fundamental component is 8.66 amp. would have harmonics having, together, an effective value of 5.0 amp. This gives a distortion factor of 0.5 or 50 percent.

Effective value of a wave containing a fundamental and harmonics is equal to the square root of the sum of the squares of the effective value of the fundamental and the squares of the effective values of the harmonics. Electronic control of welders, motors, etc., accomplished by control of the portion of the cycle utilized, may give rise to large values of distortion factor. Values to be expected are indicated in Fig. 1 where the portion of the sine wave used is as indicated. A peaked wave containing a fundamental and a third harmonic only, with a distortion factor of 40 percent is shown in Fig. 2. This percent distortion is not uncommon in exciting currents of transformers.

Performance With Distortion

A study of the factors which control the registration of typical watthour meter elements, checked by experimental study under definitely controlled conditions, shows that modern meters should perform satisfactorily unless the degree of distortion is unusually large. The elements of a watthour meter should give satisfactory performance under most conditions of operation if adjusted carefully according to usual procedures. In cases of distortion factors too large to be neglected, special calibration methods would be needed.

Meters of recent designs, of the various manufacturers, are nearly alike in the fundamental pattern of their magnetic circuits. The many minor differences have little effect on the performance of the meter element under usual conditions but do influence the degree of error with abnormal waves of current or voltage. The various parts of the magnetic circuits of a meter element are designed to operate at differing flux densities. Some parts such as the overload compensation, temperature compensation and lag adjustment may actually approach saturation under specific load conditions.

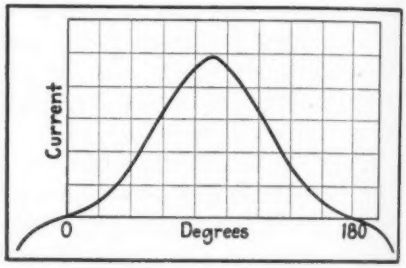


FIG. 2—Peaked wave embodying third harmonic with distortion factor of 40 percent

This variation in magnetic density in the different parts introduces distortion in the magnetic field which can be considered from two different points of view. There is a distortion in the distribution of the field in the space around the disk at any instant of time. This non-uniformity in the flux density at these various points in the air gap is usually considered, analytically, as a fundamental and harmonics in the distribution in the space adjacent to the disk.

There is also a distortion in the variation of the field strength at any particular point in the magnetic cir-

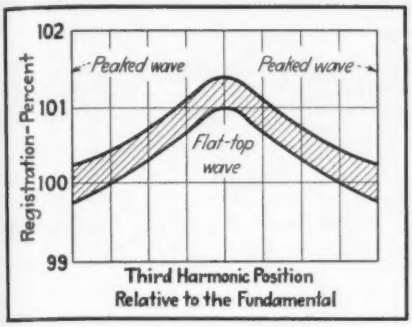


FIG. 3—Flat-top wave (with 40 percent distortion due to third harmonic) gives 1 to 1½ percent increase in registration

cuit from one instant of time to another. Likewise, this irregular variation of the field strength is usually considered, analytically, as a fundamental and harmonics in the variation of the flux as time passes.

Torque which causes the disk of a watthour meter element to rotate is the result of the interaction of the fluxes produced by the component magnetomotive forces of the potential and current elements and the disk current which results from the changing of these fluxes. These flux changes may be in magnitude or position or both. The distribution of these fluxes in the air gap and their variation in magnitude as a function of time will determine the disk torque at any instant. The time variation of the air gap flux is determined largely by the external circuit or type of load, although some influence can be attributed to the design of the meter. Space distribution of the air gap flux is dependent almost entirely on the magnetic circuit design. It is intended here to discuss the effects of variation in wave form of current and voltage as fixed by the load on the registration of the meter element for that load.

Non-Linear Elements

Conditions existing for circuits where the voltage and current are non-sinusoidal (containing harmonics) are dependent upon all components, i. e. fundamental and harmonics. If harmonics are present to an important degree in power circuits, they can be traced to the non-linear response of iron in magnetic circuits to magnetization or to the presence of a non-linear circuit element such as an electronic device which may conduct during a portion of a cycle only. Usually the most prominent harmonics are the third, fifth, seventh and eleventh. In many instances the third harmonic is the only one of importance and for this reason the effects of this harmonic alone was quantitatively studied.

Torque should be developed in the meter element only when a voltage component and current component of the same frequency are present since in such instances only is there a net transfer of energy. This condition applies to harmonics components as well as to the fundamental alone. Unfortunately, it has been found by experiment that this is not true in all instances. Net torques are produced even though voltages and currents of different frequencies are used together. It is necessary to differentiate between the meter voltage and current and the air gap flux conditions that result from them.

The iron in the magnetic circuits of the meters with its non-linear response to magnetizing forces will give rise to time variations in the fluxes which are not present in the magnetizing forces. These flux components introduced by the magnetic response of the meter parts may provide torques not accounted for by the components of the current and voltage. Torque components produced by these flux harmonics may be positive or negative with reference to fundamental torque. Presence of these additional component torques was checked experimentally.

Results obtained when only a fundamental voltage was used on the meter potential coil and a non-sinusoidal current containing a third harmonic was passed through the current element are shown in Fig. 3. The distortion factor was 40 percent. The shaded area indicates the maximum variation for several meters of modern design and various manufacturers. The meters were adjusted to 100 percent registration on fundamental voltage and current.

Errors in registration being caused by the interaction of the harmonic components of the current with the harmonics introduced in the potential coil flux by the non-linear iron parts, vary in magnitude with the relative timing of these components as well as their magnitude. For the test results of Fig. 3, the timing was varied by changing the wave form of the current, keeping the magnitude of the third harmonic constant. It will be noted that as the current wave changed from a peaked wave to a flat top wave, the registration increased, comparatively. All the registration curves came within the shaded area.

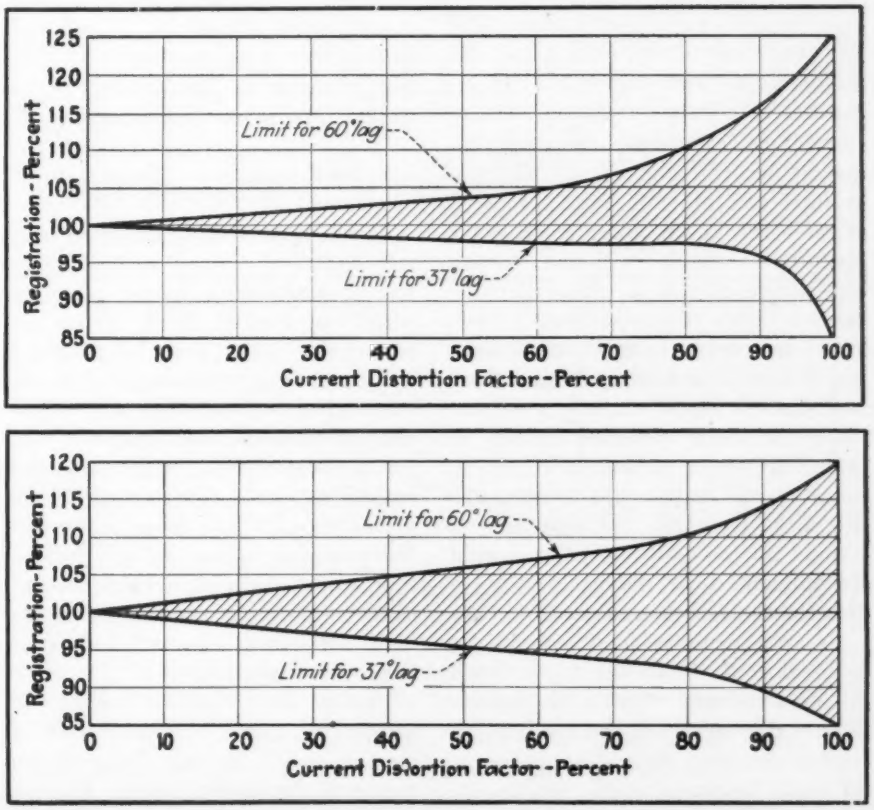


FIG. 4—Tendency to run faster with more lag of current when currents are distorted. Curves are for two different makes of meters

Some curves varied between the maximum limits of the shaded area while others were well within the area.

Range of Errors

Limits of change in registration for several meter elements (of the same manufacturer) as the current distortion was increased and also as the displacement angle between the current and voltage was increased from 37 deg. lag to 60 deg. lag are indicated in Fig. 4a. Fig. 4b shows the corresponding limits for several meter elements of another manufacturer. The curves for the various meter elements of the same make were not identical, although exceptional care was exercised in adjusting each meter element to correct registration for sinusoidal voltage and current conditions. The slightest variation in the meter parts contribute to air gap, flux variations which finally influence the meter registration. Registration bands for a group of meter elements of the same manufacturer are shown (Fig. 5). For the tests illustrated by these curves both the potential and current contained harmonics of the same order and the registration of the meter element depended upon the net torque produced by these various harmonic components. Differences in characteristics were caused by the greater phase shift of harmonics from that given the fundamental with consequent effects on the component torques.

For meters which have been adjusted according to recognized procedures and limits of error, the registration errors resulting from wave distortion usually will not exceed the permissible error unless the distortion factor is greater than 30 percent. In order to measure, accurately, the energy consumed by loads having a distortion factor exceeding 50 percent, the meter elements should be adjusted under actual load conditions using indicating instruments. Rotating standards or test meters should not be used since they would be influenced in the same way as the meter elements under test.

In this connection it might be pointed out that for loads such as electronically controlled welders where the current is intermittent as well as distorted, an additional source of error in registration may be introduced by the intermittency of the load. This is caused by differences

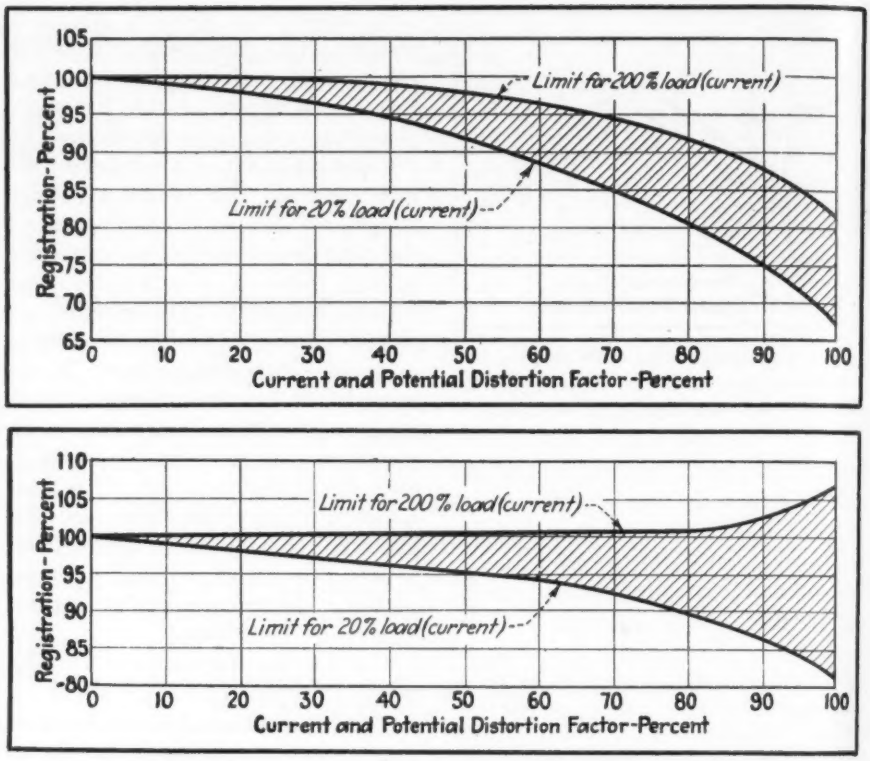


FIG. 5—Tendency is to register higher for heavier current loading for both unity (fundamental current and voltage in phase) and lagging (37 degrees) power factors as distortion factor is increased. Curves are for a single make of meter

in the damping torques in the meter element during disk acceleration and deceleration resulting from the load pulsations. Where loads of this nature are to metered alone, special consideration should be given to adjusting the meter elements. Indicating instruments are advisable for testing meters used with such loads.

High Frequency Equipment

Much present day equipment utilizes electrical energy at frequencies higher than that of the power system which supplies it. If the frequency conversion is by a motor-generator set, the energy measurement is accomplished without difficulty. However, if electronic equipment is used for the conversion, high frequency components may be present in the power supply. For these conditions the previous discussion of registration apply. If it is desired, in any case, to measure the energy at the high frequency, specially designed meters are necessary.

Present day watthour meter elements, in order to reduce cost to meet competition, are designed for a narrow frequency range. Even at the frequency of approximately 400 cycles, used in high speed tool applications, the registration curve of a typical watthour meter element would be radically different from its normal registration curve. Such increase in the frequency would decrease the potential flux and alter the effects of all compensating devices. For this reason there would be no single value that could be used as a disk constant for the element with variable load, at such increased frequency. Undoubtedly, for cases of constant load only, the meter could be used to measure the energy if the proper disk constant could be determined at frequencies somewhat in excess of its rated frequency.

Work is being done at the present time by the meter manufacturers on meter elements for this class of service. Such meters, no doubt, would be costly, comparatively, since their production would be limited.

It can be stated, finally, that in the vast majority of instances no concern need be had over the influence of harmonics on meter registration unless the wave of distortion is great. Where loads of importance are suspected of introducing appreciable distortion in the currents of a system, a study of the wave form and the meter element registration may be desirable.

New Distance Relays Know Faults from Swings

Calculating board studies reveal why conventional distance relays operate on out-of-step condition — Criteria established for improvements that afford discrimination as to phase angle as well as magnitude of successive impedance values

W. A. MORGAN, Engineer, Bureau of Reclamation, Denver, Colorado

POWER OPERATING engineers are familiar with the fact that conventional distance relays operate on out-of-step conditions, but it has not always been clear just what was happening to cause the relay operation. The results of some calculating board studies herein presented may help to give a clearer picture of how an out-of-step condition differs from a line fault, as the relay sees it, and why the newer types of distance relays are required.

Board Studies Made

Studies were made of the heavily loaded Parker Dam—Phoenix 161-kv. transmission line which has had several relay operations due to out-of-step conditions caused by faults elsewhere on the interconnected power systems. When it was decided to build a second Parker-Phoenix 161-kv. transmission line, a calculating board study was made to determine what relay characteristics would be required to prevent relay operations for out-of-step conditions with the two lines in service.

The two lines are about 140 miles long and will each be provided with 20-cycle reclosing breakers in the final installation with carrier relaying to insure simultaneous clearing of both ends of each line. Both lines will be provided with overhead ground wires. Fig. 1 shows a schematic diagram of the essential part of the system studied.

Impedances Ascertained

In order to look at the power system conditions from the standpoint of the relays the impedance was measured at the relay locations on the complete miniature system set up on the calculating board. The phase angle and magnitude of the impedances at the relay locations were determined by measuring the voltage and current phase angles and magnitudes and dividing the corresponding vector voltage by the vector current. Since stability power-swing

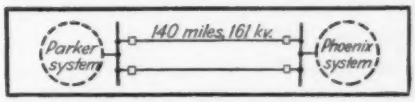


FIG. 1—Initially there was only one line, without reclosing breakers on the Parker-Phoenix interconnection. Soon there will be two, with reclosing breakers and carrier relaying

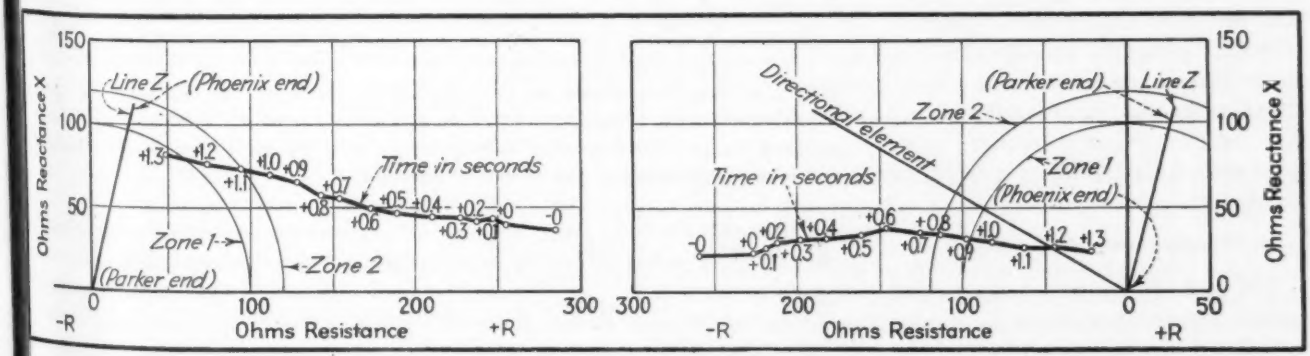


FIG. 2—(left) Input impedance viewed from the sending (Parker) end of the line. Line Z represents impedance of the single line (27 + j 110 ohms). Arcs marked "zone 1" and "zone 2" show approximate settings of the distance relays. Point "—0" is the impedance corresponding to the power over the line just prior to the fault while point "+0" corresponds to the impedance of this power just after the fault. Points "+0.1," "+0.2," etc., correspond to the impedances at time-intervals of 0.1 second, 0.2 second, etc. after the fault occurred

FIG. 3—(right) Out-of-step impedances as viewed from the power receiving (Phoenix) end. Relay location for the same fault conditions as for Fig. 2. The out-of-step impedance here enters the relay tripping zone from the left side for the receiving-end relays, just the opposite from the impedance as seen by the sending-end relays

curves were being plotted for the generators of the system, and the system quantities had to be determined at 0.05- and 0.1-sec. intervals, the variation of the impedances was observed for the same time intervals.

The variation of phase angle and magnitude of the impedance is shown by plotting the resistance and reactance components on a resistance-reactance, or R-X, diagram. The impedance appears on the right side of such a diagram for the power sending end relay location, with lagging power factor impedance appearing in the upper right quadrant and leading power factor impedance appearing in the lower right quadrant. Conversely, for the power receiving end relay location, the impedance appears in the lower left quadrant for lagging power factor and in the upper left quadrant for leading power factor.

Out-of-Step Locus

How the impedance varies during an out-of-step condition on the single heavily loaded 161-kv. line which was initiated by an external fault on the interconnected systems is shown in Fig. 2.

Impedance which the relays see (Fig. 2), corresponding to the out-of-step condition, moves into the relay tripping zone from the right, almost at right angles to the line impedance. Except for the effect of fault arc resistance, any faults on the line would appear along "Line Z," and would reach their final values at once. The difference between a fault and an out-of-step condition as it appears to the distance relay is that the fault impedance is confined to points along the transmission line impedance characteristic and reaches its value at once, whereas the out-of-step impedance has no definite value but enters the tripping area from the right side.

Phenomenon of Instability

The out-of-step impedance which causes the distance relays to operate is related to the condition of instability (Fig. 4) which the power system is undergoing at the same time. It is seen that the angular displacements between the machines of the Parker end of the system and of the Phoenix end of the system are steadily increasing with no indication of ever coming back into step at the same time that the impedance is being reduced to a value to cause relay operation.

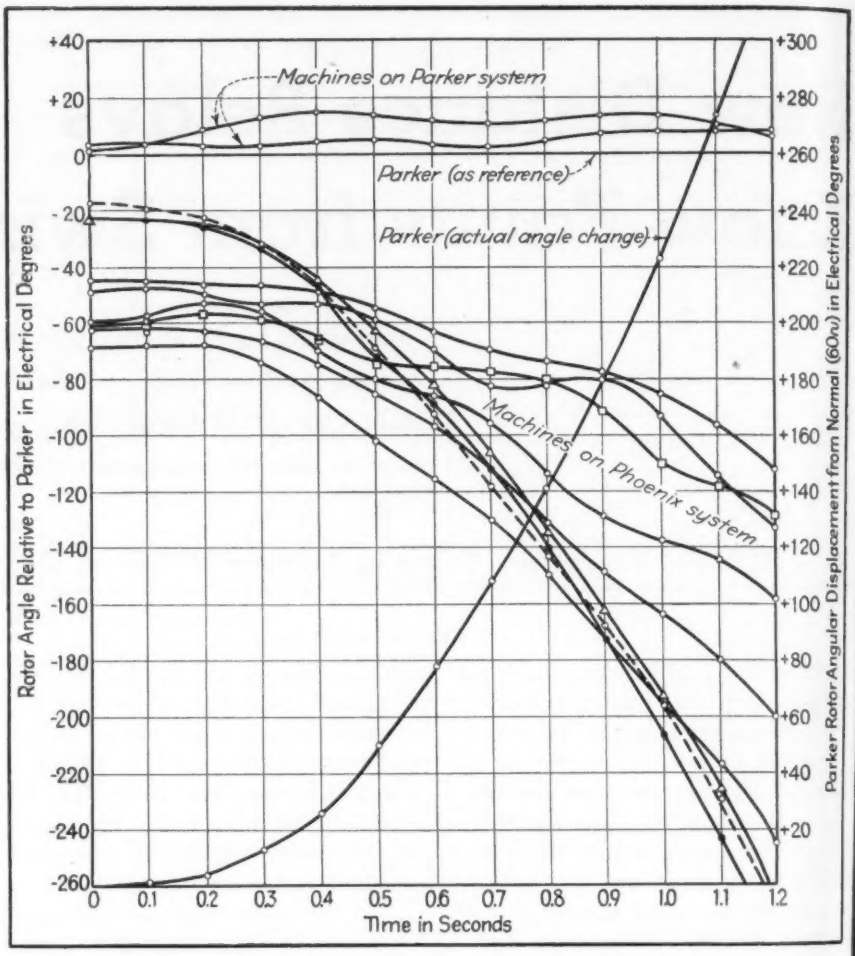


FIG. 4—Power swing curves corresponding to the impedance curves of Fig. 2 and 3. These are plotted in terms of angular displacement between the machine rotors and the time in seconds

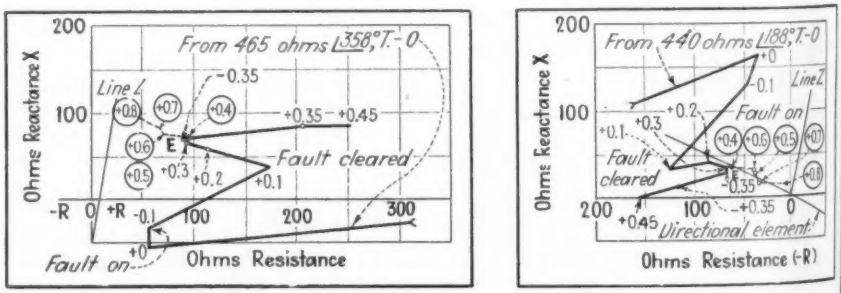


FIG. 5, 6—Input impedances as seen by the Parker relays on the unfaulted line. Impedance corresponding to the initial load conditions is off-scale to the right of the left-hand figure. Corresponding impedances as seen by the relays at the Phoenix end of the unfaulted line are shown at the right

With the second Parker-Phoenix 161-kv. transmission line in service it is essential that the unfaulted line relays do not trip for faults on the other line because of out-of-step impedances. Fig. 5 shows the impedances as seen by the Parker relays on the unfaulted line. The impedance corresponding to the initial load conditions is off scale, but point "+0" corresponds to the impedance after the fault is applied to the other line. Point "—0.1" corresponds to the impedance just before the fault is cleared, and point "+0.1" is for just after the fault is cleared. The 0.1-sec. interval corresponds to 6 cycles. After the fault on the one line is cleared, there is left a load on the remaining unfaulted line that is beyond its capacity. Therefore, the impedance starts to reduce as the incipient out-of-step condition devel-

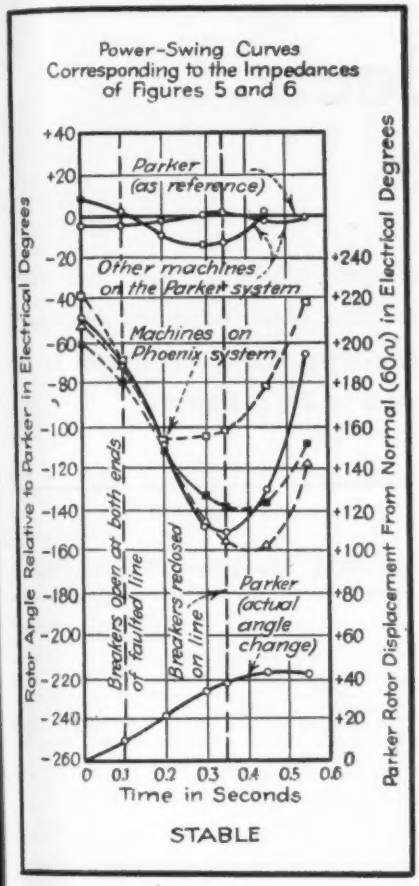


FIG. 7—Power-swing curves corresponding to the impedances and times shown in Fig. 5 and 6. Stability recovered by rapid reduction of the angular displacement after breakers closed (at 0.35 seconds, 21 cycles)

ops; note that successive impedance points "+0.2" and "+0.3" approach the relay tripping zone.

If nothing is done the impedance would follow the course shown by the dotted line and would cross "Line Z" which would mean certain relay operation on the unfaulted line at about 0.9 sec. due to the out-of-step impedance. However, if at about 0.35 sec. (21 cycles) the fast reclosing breakers reenergize the previously faulted line, the two lines together can again safely carry the load, and the incipient out-of-step conditions are dispelled. As seen in Fig. 5, if the fast reclosing breakers operate to reenergize the previously faulted line within 21 cycles the impedance follows the full line from point "−0.35" to "+0.35" and "+0.45" and away from the relay tripping area toward the impedance that existed before the fault occurred.

Power-swing curves of the generators are shown in Fig. 7 for the same fault conditions corresponding to the impedance diagrams shown in Fig. 5 and 6. It is seen that the angular displacement between the Parker system machines and the Phoenix system machines is rapidly increasing even after the fault is cleared by opening both breakers on the faulted line. However, when the breakers are reclosed at 0.35 seconds (21 cycles) it is seen that stability is quickly reestablished by the rapid reduction of the angular displacement between the Parker and Phoenix machines.

Relay Characteristics

By making several studies for different loading and connected generation conditions it was possible to determine just what relay characteristics would be necessary to prevent false relaying on the good line for faults on the other. Without going into a detailed discussion of the various studies made, Fig. 8 and 9 show the outline of the only areas for which the line relays were desired to operate and they were made a part of specifications for the line relays. If the relays operated for any other impedances, they would open the good line just as stability was about to be reestablished by the reclosing of breakers on the previously faulted line. The conventional type distance relay would operate on impedances outside the areas indicated and are not satisfactory for this application. However, the newer types of distance relays can discriminate as to the phase angle as well as magnitude of the impedance and can be made to accomplish the desired result. These newer relays are described in references 2 and 3.

1. Performance Requirements for Relays on Unusually Long Transmission Lines, F. C. Poage, C. A. Streifus, D. M. MacGregor, E. E. George. *AIEE Transactions*, Pages 275–83, June 1943.

2. The MHO-Carrier Relaying Scheme, R. E. Cordray, A. R. van C. Warrington, *AIEE Transactions*, pages 228–35, May 1944.

3. A Distance Relay with Adjustable Phase—Angle Discrimination, S. L. Goldsborough, *AIEE Transactions*, pages 835–38, November, 1944.

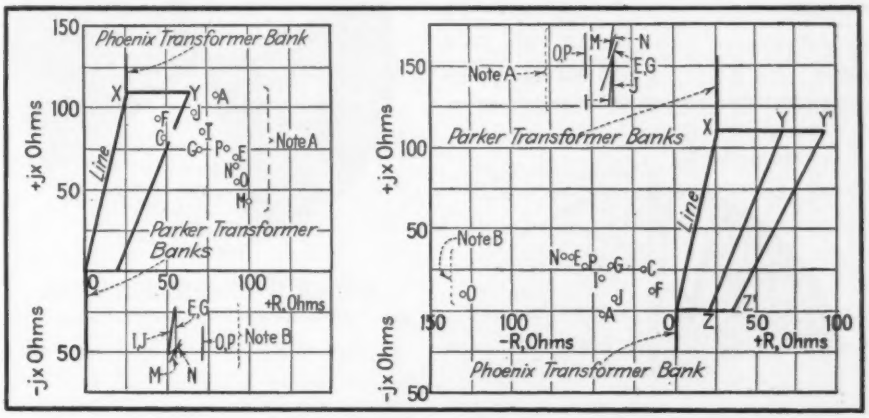


FIG. 8—(left) Requirements specified for relays for Parker terminal. It is desired to trip trip instantanously for impedances in area OXYZ whether caused by power swings or faults, and to trip in a delayed or back-up time for faults in the Phoenix transformer bank but not for faults on the low voltage side of this transformer bank. It is not desired to trip for the impedances indicated by small circles or lines and designated A, E, G, I, M, N, O, and P. Tripping in a delayed or back-up time will be allowed for impedances designated J

Note A. Minimum values of impedance during power swings for different system conditions

Note B. Impedances during time that faults are on the parallel transmission line, corresponding to the initiating conditions causing some of the power swings above.

FIG. 9—(right) Requirements specified for relays for Phoenix Terminal. Trip desired to instantaneously for impedances in area OXYZ whether caused by power swings or faults, and to trip in a delayed or back-up time for faults in the Parker transformer banks but not for faults on the low voltage side of these transformers banks. In addition, it is desired to trip in back-up time or faster for faults having impedances in area YY'Z'Z. It is not desired to trip for the impedances indicated by small circles or lines and designated A, E, G, I, M, N, O and P. Tripping in a delayed or back-up time will be allowed for impedances designated J. Tripping is desired for impedances C and F since the corresponding points in Fig. 8 are in the tripping area OXYZ.

Note A. Impedances during time that faults are on parallel transmission line, corresponding to the initiating conditions causing most of the power swings below.

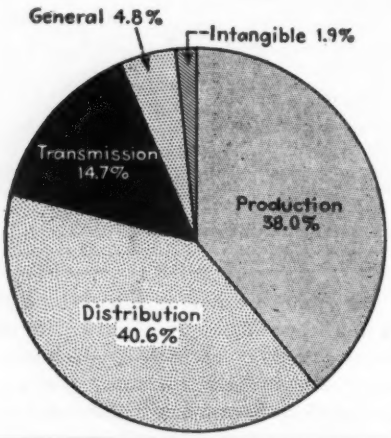
Note B. Minimum values of impedances during power swings for different system conditions

Investment Ratios of Electric Utility System Elements

Analysis of electric utility plant investment based on 234 reporting companies—Distribution and transmission plant accounts represent three-fifths of total—Two-thirds of production plant investment is for steam generation, carried at an average of $98 per kw.

TABLE I—Total Plant

Item	Amount ($1000)	Percent
Production	2,256,622	38.0
Distribution	2,422,727	40.6
Transmission	880,198	14.7
General	288,978	4.8
Intangible	117,924	1.9
Total	5,966,949	100.0



Distribution is generally known to be the largest single element in electric utility plant investment. It has been frequently spoken of as anything from a third to a half of the total, depending on the source of the speaker's information. Now, the proportion of distribution in total investment can be referred to as a national average. It is 40.6 percent.

This and other system element ratios are derived from data in the book, "Statistics of Electric Utilities in the United States," for 1943, published by the Federal Power Commission. Ratios for the other system elements, calculated at the same time, are production 38 percent, transmission 14.7, general plant 4.8 and intangible* plant 1.9. (Table I.)

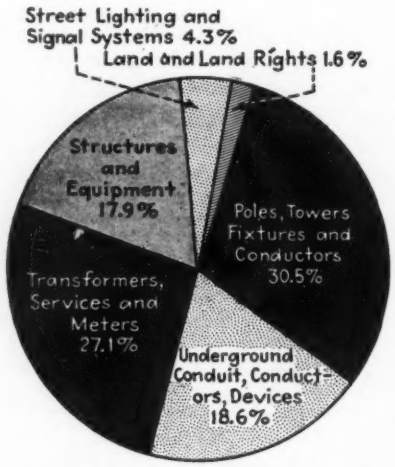

Street Lighting and Signal Systems 4.3%
Land and Land Rights 1.6%
Structures and Equipment 17.9%
Poles, Towers Fixtures and Conductors 30.5%
Transformers, Services and Meters 27.1%
Underground Conduit, Conductors, Devices 18.6%

TABLE II—Distribution Plant

Item	Amount ($1000)	Percent
Land and land rights	37,359	1.6
Poles, towers, fixtures and conductors	739,383	30.5
Underground conduit conductors, devices	450,778	18.6
Transformers, services and meters	651,188	27.1
Structures and equipment*	436,331	17.9
Street lighting and signal systems	107,688	4.3
Total	2,422,727	100.0

* Includes installations and leased property on customers' premises which represent approximately 0.3 percent of total distribution plant or $6,581,000.

The book of statistics contains reports to the Commission from 347 power companies, representing over 95 percent of the assets and revenues of the privately owned electric utility industry.

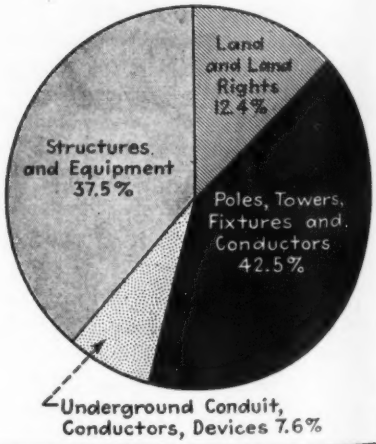
Of the 347 reports, 234 or 67 percent presented accounts completely distributed according to FPC classification. The sums of money given in the items of these reports were added together to arrive at the account totals which appear in the accompanying tables and from which the ratios of the pie charts were calculated. In the other 113 reports investments were not completely distributed to accounts and therefore could not be included in the compilation. Thus the figures given here have the validity of representation of practically two thirds of the industry, exclusive of government and cooperative operations.

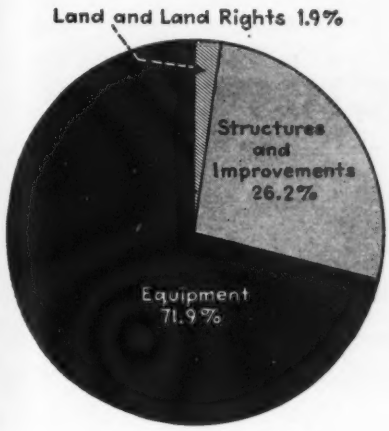
As a check on the accuracy of system element proportions so derived, a roughly comparable set of ratios was

* Intangible plant covers capitalized costs of rights, franchises, fees, etc., not assignable to other classifications.

TABLE III—Transmission Plant

Item	Amount ($1000)	Percent
Land and land rights	109,346	12.4
Poles, towers, fixtures and conductors	374,864	42.5
Underground conduit, conductors, devices	62,808	7.6
Structures and equipment	333,180	37.5
Total	880,198	100.0


Land and Land Rights 12.4%
Structures and Equipment 37.5%
Poles, Towers, Fixtures and Conductors 42.5%
Underground Conduit, Conductors, Devices 7.6%



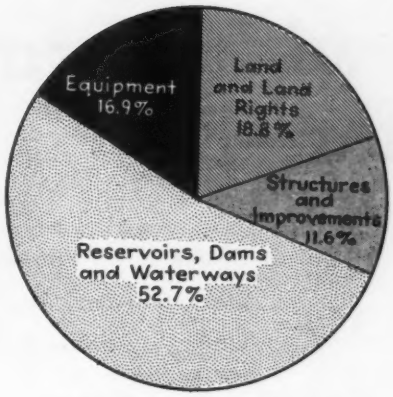


TABLE IV
Steam Plant

Item	Amount ($1000)	Percent
Land and land rights	28,764	1.9
Structures and improvements	391,614	26.2
Equipment	1,073,007	71.9
Total	1,493,385	100.0

TABLE V—Hydro Plant

Item	Amount ($1000)	Percent
Land and land rights	140,681	18.8
Structures and improvements	86,193	11.6
Reservoirs, dams and waterways	392,159	52.7
Equipment	125,717	16.9
Total	744,750	100.0

TABLE VI
Internal Combustion Plant

Item	Amount ($1000)	Percent
Land and land rights	331	1.8
Structures and improvements	2,872	15.9
Equipment	15,284	82.3
Total	18,487	100.0

calculated from the record of expenditures by the whole industry for new construction in the 24-year period, 1921-1944 inclusive, as reported in ELECTRICAL WORLD. In this period, 41.5 percent of total construction expenditures went into distribution, 32.4 percent into production, 17.6 percent into transmission and 8.5 percent into general plant. Considering the differences between the data from which they were computed, the two sets of ratios can be said to be in fairly close agreement.

The large difference between amounts of investment for "Land and Land Rights" in distribution (Table II) 1.6 percent, and in transmission (Table III) 12.4 percent, is striking. In distribution, lines are built along streets and alleys, the use of which is usually granted by franchise and it is on this use of the public ways that state and local government regulation of electric utilities is largely based. On the other hand, the much larger proportionate investment in land and land rights in transmission shows that these lines are mostly built on land owned by the utility or on private rights of way.

Another interesting comparison between these two system elements is in the items "Structures and Equipment," 17.9 percent in distribution and 37.5 percent in transmission. These figures say, in effect, that substation investment for transmission is proportionately twice as large as for distribution.

In looking at the unit figures in the right-hand column of Table VII it should be kept in mind that dollar quantities throughout this discussion are of investment, not of construction cost. They are the figures at which the different system elements are carried on books of account and they have been depreciated in greater or less degree from original cost. Probably the $98 investment per kw. for steam plant comes closer to being an expression of cost than does the $162 for hydro. According to figures published in the statistical issues of ELECTRICAL WORLD, the power companies installed 10,117,000 kw. of new steam capacity and only 777,000 kw. of new hydro in the eight-year period 1937-1944. From these figures it is calculated that over half the steam capacity shown in Table VII is less than eight years old while only about one ninth of the hydro capacity is as young.

Table VIII is offered as a final evidence of the validity of the ratios derived in this study. It shows that the proportions of production plant for the 234 companies included are practically the same as those for all power companies in the country.

TABLE VII—Capacities and Unit Investments

Generating Stations	Number of Companies	Amount ($1000)*	Capacity (kw.)	Investment Per kw.
Total Steam Plants	144	$1,490,945	15,245,652	$98
Total Hydro. Plants	106	735,004	4,611,326	162
Total Int. Comb. Plants	57	15,914	136,455	117

* Figures in this column are less than those in Tables 1, 4, 5 and 6 because a few of the companies reporting investments in production plant did not also report capacities.

TABLE VIII—Production Plant Capacity Ratios

	Companies Included in Study		All Power Companies	
	kw.	% of Total	kw. (1943)	% of Total
Steam	15,245,652	76.2	30,113,828	76.9
Hydro	4,611,326	23.2	8,647,034	22.2
Int. Comb	136,455	.6	336,965	.9

Disinfection with Germicidal Lamps: Water—III*

Design much different from air control—Data on absorption coefficients and germicidal energy transmission for water of different cities as well as disinfection rates

MATTHEW LUCKIESH†, General Electric Co., Cleveland, Ohio

THE TRANSMISSION of clear water for λ2537 is greatly influenced by extremely minute quantities of compounds in solution. For example, we found distilled water to be quite transparent to this energy. We dropped a tack into a gallon of this water and after three days found that the transmission-factor of a 5-in. depth decreased from 95 percent to 61 percent. The same depth of Cleveland water taken from hot and cold water taps had transmission-factors of 34 and 53 percent, respectively. Boiling, filtering and even exposure to germicidal energy alters the transmission coefficient of water. These few glimpses indicate the marked differences among clear drinking waters and also the great fundamental difference in the design of installations for disinfecting air and water, respectively.

Transmission Factors

The differences among clear waters are well illustrated by Fig. 1, which shows the transmission-factors of various depths of eight different waters.[1] Distilled water is quite transparent at a depth of 2 ft. and more. The water from a concrete cistern was highly absorbing. Only 1 percent of the germicidal energy reached a depth of 6 in.

In Fig. 2 is shown the cross-section of an aluminum tank 40 in. long for disinfecting water. A 30-watt, 36-in. germicidal lamp is in the foci of two parabolic reflectors. The intensity of germicidal energy in microwatts per square centimeter is shown at various levels with and without water in the tank. The water in this case had a fairly high absorption coefficient. A depth of 1 ft. transmitted only 23 percent of the incident energy and a depth of 19 in. absorbed 90 percent of the incident energy. It is seen in Fig. 2 that the intensity of the germicidal energy decreases rapidly as the depth of water increases. The results of extensive researches with B. coli in water indicate that, for practical purposes, the relationship between survival-ratio and exposure to germicidal energy approximates the theoretical exponential law.

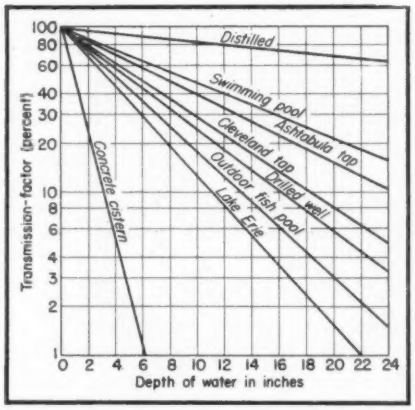


FIG. 1—Transmission factors for germicidal energy for various depths of eight different waters

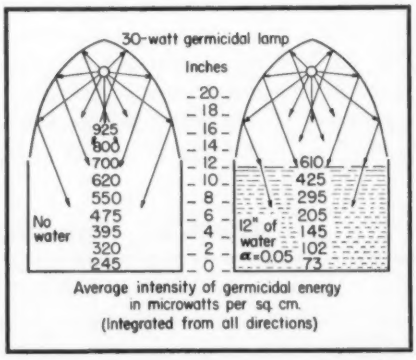


FIG. 2—Cross-section of an aluminum disinfecting water tank. Intensities of germicidal energy are shown for various levels with and without water in the tank

Rate of Disinfection

In Fig. 3 there are indicated the rate of disinfection of various waters to various survival-ratios of B. coli for each lamp used as indicated and for waters of different absorption coefficients. The absorption coefficients of waters from cold water taps in 19 different cities are shown in Table I along with other data.[2] It is particularly of interest to note that the depth of water which absorbs 90 percent of the incident germicidal energy varies from about 35 in. to about 5 in.

In Fig. 3 is shown the influence of the absorption of water upon the rate of disinfection of the water to various survival-ratios of B. coli. It will be noted that the range of absorption coefficients is greater than their range for the 19 waters listed in Table I. Obviously the gallons of water that can be disinfected per hour per 30-watt germicidal lamp decreases as the absorption coefficient increases and as the survival-ratio decreases. The exponential law of transmission is ex-

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* This completes the article. Two previous parts covered appraisal of germicidal energy (September 29, 1945, page 72) and air purification (October 13, 1945, page 109).

† Director Lighting Research Laboratory.

[1] "Disinfecting Water By Means of Germicidal Lamps," Matthew Luckiesh and L. L. Holladay, *General Electric Review*, 47, 1944, 45.

[2] "Germicidal Energy," Matthew Luckiesh, A. H. Taylor and G. P. Kerr, *General Electric Review*, 47, 1944, 7.

pressed as $t = e^{-ad}$ where t is the transmission factor of depth d of water with an absorption coefficient a.

In Table II are the rates of disinfection of the various waters computed from the basic experimental data with B. coli. No factors of safety are included and it is emphasized that these values are for pathogenic germs. We have worked with molds, fungi and algae but can only state at the present time that they are generally

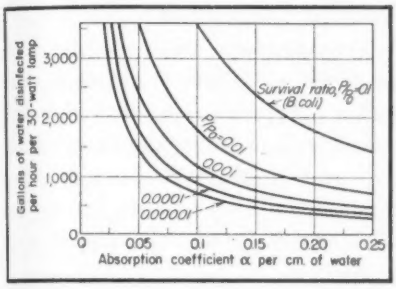

FIG. 3—Rate of disinfecting water depends upon the absorption coefficient of the water and the degree of killing or survival ratio desired

much more resistant. Possibly some of them cannot be penetrated sufficiently by this germicidal energy to kill them.

In considering these data for waters from various cities, it should be borne in mind that the water was drawn from cold-water taps and shipped in glass-stoppered glass bottles. The absorption coefficient in a given case may not be representative of the water throughout that city. The chief purpose of the data is to indicate the great variation in absorption coefficient among various drinkable waters and how this affects the rate of disinfection of water.

As many tanks similar to that illustrated in Fig. 2 may be used in series or in parallel as may be necessary. Naturally as the water flows from one to another it should be "turned over." This is readily accomplished by flowing in at the bottom at one end and out at the top at the other end. Baffles used in the tank intercept the energy and absorb it to some degree.

Our recommendations are to treat the water outside the pressure system if possible. Wherever it is necessary to treat the water under its normal pressure it is obvious that difficulties are involved in both installation and maintenance.

It is emphasized again that germicidal energy can scarcely compete with chlorination for large water-supply systems. However, there appear to be many applications of germicidal lamps in the disinfection of water for homes, institutions, industrial purposes, and water-supply systems in the smaller communities.

In Conclusion

In the foregoing paragraphs only major highlights of the subject have been presented. However, they should reveal the basic principles and the practical possibilities. Knowing what this germicidal energy will do, and how to control it and apply it, should lead to countless uses. But knowledge of its limitations and its possibilities of harm to living and non-living things is also essential. Extravagant claims and unwise applications are bound to be made. All these will hamper the growth of this activity which must be developed upon faith in basic facts and in accumulated measurements.

Various measuring devices have been developed by the author and his colleagues and will be available for those who need them. A very simple device used with a foot-candle-meter measures the intensity of germicidal energy near the lamp. Another simple device measures very low intensities such as those at the occupant level in a room whose upper air is being irradiated. It is necessary to keep the intensity on human eyes and skin to a low value of the order of 0.1 microwatt per sq. cm. More elaborate devices have been developed for laboratory use and serious investigations in the field.

All these devices have their place, for the growth of any science or practice is largely an accumulation and coordination of measurements. However, practice in this field as in other fields will be largely a matter of installing a sufficient number of germicidal lamps in the proper manner to accomplish the results indicated by basic investigations. For new applications which have not been provided with the necessary basic knowledge, measurements of germicidal energy may suffice. However, the final verdict rests upon determinations of the killing of all or of a sufficient percentage of the bacteria in any given case.

Table I

The Transmission of Germicidal Energy (λ2537) by Water from Various Cities of the United States.

The transmission varies exponentially with the depth d of clear water. The transmission $t = (1 - r)\, e^{-ad}$ where r is the fraction reflected at the surface and a is the absorption coefficient of the water. Since r is approximately equal to 0.02, $t = 0.98e^{-ad}$.

City	Absorption Coefficient a		Percent Transmitted by			Depth in Inches for 90 Percent Absorption
	Per Cm.	Per In.	3 In.	6 In.	12 In.	
Atlanta	0.0258	0.0656	80	66	45	34.8
Cleveland	0.0471	0.120	68	48	23	19.1
Philadelphia	0.0514	0.131	66	45	20	17.5
Buffalo	0.0546	0.139	65	43	19	16.5
Detroit	0.0562	0.143	64	42	18	16.0
Chicago	0.0611	0.155	62	39	15	14.7
Pittsburg	0.0782	0.199	54	30	9	11.5
LaGrange, Ill	0.0782	0.199	54	30	9	11.5
New York	0.0804	0.204	53	29	8.5	11.2
Dallas	0.0804	0.204	53	29	8.5	11.2
Portland, Ore	0.0827	0.210	52	28	7.9	10.9
Denver	0.0896	0.228	49	25	6.4	10.0
Oakland, Calif	0.102	0.258	45	21	4.4	8.85
Minneapolis	0.142	0.360	33	11	1.3	6.34
Kansas City	0.166	0.422	28	7.8	0.62	5.41
Akron, Ohio	0.177	0.449	26	6.6	0.45	5.09
Los Angeles	0.178	0.452	25	6.5	0.43	5.04
St. Louis	0.184	0.468	24	6.0	0.36	4.88
Boston	0.184	0.468	24	6.0	0.36	4.88

Table II

Computed Rate of Disinfection of Water from Various Cities

City	Gallons of water per hour per lamp for three survival-ratios of B. coli		
	0.1	0.01	0.001
Atlanta	14,000	7,000	4,500
Cleveland	8,000	4,000	2,500
Philadelphia	7,000	3,500	2,400
Buffalo	6,500	3,300	2,200
Detroit	6,400	3,200	2,200
Chicago	5,800	3,000	2,000
Pittsburgh	4,500	2,300	1,500
LaGrange, Ill	4,500	2,300	1,500
New York	4,300	2,200	1,500
Dallas	4,300	2,200	1,500
Portland, Ore	4,200	2,200	1,500
Denver	3,900	2,000	1,300
Oakland, Calif	3,500	1,800	1,200
Minneapolis	2,500	1,300	800
Kansas City	2,100	1,100	700
Akron	2,000	1,000	700
Los Angeles	2,000	1,000	700
St. Louis	1,900	1,000	650
Boston	1,900	1,000	650

Editorials

S. B. WILLIAMS, *Editor*

Preparation for a Possible Clean Air Issue

SO WELL INFORMED is the American public becoming about even abstruse technical matters that there doesn't seem to be much point in keeping things from them. Somebody will tell them sooner or later, anyhow, and it's just as well if that somebody is someone other than a politician. That fraternity is already, now the war is over, looking around for local campaign issues. One of the things that may be a slogan in murky cities is "pure air." A lot of dust will be thrown in the eyes of the citizens about that issue. Must that dust come from utility stacks and fuel piles? Not if the power companies anticipate the issue.

All the way from the Surgeon General's office down to the municipal smoke inspector there is a chance to tell what utilities have been doing to minimize the emission from the boilers and stacks. The dust is being removed electrically or mechanically before the gases emerge. The coal piles are being compacted in a way that prevents both fires and dust-blowing. Much coal is treated at the mines and there are treatments for the sides and tops of the piles.

Not only is something being done by forehanded companies but more of them are seeing the need for acquiring more knowledge of the art of dust collection, its measurement and analysis. The call is for many more to familiarize themselves with the technical ramifications. Microns, microscopics, sampling, chemical analysis are matters which warrant study.

Litigation is an expensive and inconclusive thing—generally to be avoided. When it is inevitable because some ward-heeling politician or ambulance-chasing lawyer starts something for ulterior purposes, it is an asset to have the defense ready. The defense can be that everything possible and reasonable is being done and that ought to suffice if lucidly demonstrated. If it does not suffice then the knowledge of the technicalities affords a chance to finger-print the soot and dust complained of and demonstrate that it must have come from other than utility sources. Believe it or not, that is said to have been achieved in one fairly recent instance.

Minimizing Flood Consequences

WAR-TIME DEVELOPMENTS will be offering many instances of civilian usefulness and perhaps such contributions can pay additional rich dividends on the original cost. One that seems to offer such possibilities is the minimization of damage to electrical equipment from floods. Measures can be taken to keep floods out of power plants and substations, but somehow or other bigger and better floods have a habit of putting in appearance. The alternative is to let the high water enter but try to minimize the temporary injury to electrical insulation and oil-filled and oil-lubricated equipment.

In that connection consideration might be given to war materials and procedures devised to protect deck shipments against weather and rough seas, as well as for protection of delicate electrical apparatus against the high humidity of the tropics and jungles. Some of the less delicate but equally vulnerable equipment on power systems might suffer less quickly and less completely if similar measures were applied.

Another development that might be studied is a comprehensive line of fittings for merchant marine ships and naval vessels to insure water-tightness of bulkheads despite the power, control and signal circuits extending through them. Here again it would appear that some of these new principles and designs could be helpful in preventing wetting of power leads and control cables when sudden floods occur.

Interconnections have been outstandingly effective in keeping the territories served when area floods knock out some of the key generating and transfer points. But recent floods have been establishing new highs and mere caution should prompt the adoption of all minor measures that can avert expensive alterations at old and middle-aged plants.

Old Home Relighting

IN LINE with the ever-present, never-solved problem of residential rewiring is the relighting of homes. Why is it that the electrical industry finds no great obstacles to the relighting of stores, offices, factories, but when it comes to the home, except perhaps for the kitchen, it is licked?

For all other occupancies the industry has found real benefits to be derived from improved lighting. The benefits that would be derived by the home are just as real, but the way has not been found to present them. Certainly there is no class of buildings more sadly in need of better lighting than those built during the last building boom and earlier.

Some years back the utilities put on kitchen relighting campaigns and they were remarkably successful. The I.E.S. lamp also was promoted and until stopped by the war had made considerable headway. Fixed lighting, on the other hand, outside the kitchen, has not received the attention it needs.

More than a little of the difficulty in the past can be laid on the doorsteps of the manufacturers who were more concerned with styling for daytime appearance than with the quality of lighting. Women, particularly, have built up a prejudice against fixed lighting, largely because it was uncomfortable as installed.

New recommendations for home lighting practice and for equipment performance have recently been made available by the Illuminating Engineering Society. Also, the manufacturers are committed to furnish certified designs that have as much attention paid to the light quality as to the esthetic. With the basic tools and proper equipment at hand, it should be possible to do as good a job with the old homes as with the old stores. If it can't be done all at once for the entire home, maybe a room-by-room package campaign would produce results. Certainly if one of the upstairs rooms is relighted the others will follow before long.

The old home stands as a challenging relighting market and somebody in this industry ought to be smart enough to find the key to open it. Never will we do a full job of relighting America until we have modernized the lighting in our homes.

Farm Modernization, Not Electrification

FOR YEARS people have talked of "farm electrification" as the big job—electrify the farm, thus make it an efficient producer, increasing output and profit. Electrification, however, is only a part, and, in terms of expense and of required change, frequently a lesser part of the job of "industrializing" the nation's farms. What is to be done is to remodel, rearrange, revise, and change farm structures and operations so as to bring farming to something approaching the productive efficiency of modern industry. In this task the provision of facilities by which electricity is utilized in motion, light and heat to perform farm tasks is not a minor part, but it is not by any means the largest.

Consider a hay drier, for instance. The electrical elements are a motor, control equipment and wiring. Required also are a blower and a duct system and for the latter it may be necessary to make more or less extensive repairs or structural alterations. Or it may be advisable to build a new barn rather than to spend money to put the hay drier and other modern facilities into an old one. There are other instances where the mechanical and structural elements outweigh the electrical in cost.

Electricity is useless on the farm, as everywhere else, until transformed into other forms of energy. And in the usual case what is necessary for the utilization of electricity greatly outweighs, as regards cost and change, the provision of electrical facilities.

Industrializing the farm is an affair, then, of farm modernization, in which electrification is included but is not by any means the whole story, although it may be the main spring. It might be hastened if the popular emphasis could be shifted from the part to the whole and people made to see that all responsibility for making the farm a factory does not rest on the shoulders of the electrical industry.

Our War Citation

HERE FOLLOWING is a letter of which the editors of ELECTRICAL WORLD are proud. It is printed without apology because in final analyses the credit belongs to the readers of the magazine. It is their requirements of quality and enterprise in editorial performance that make ELECTRICAL WORLD capable of earning such commendation.

Mr. James H. McGraw, Jr., President
McGraw-Hill Publishing Company
330 West 42nd Street
New York 18, N. Y.

Dear Mr. McGraw:

In winding up the Office of War Utilities of the War Production Board, I wish to express to you my sincere appreciation for the splendid support which has been given to us by ELECTRICAL WORLD and all of the McGraw-Hill publications.

At the beginning of the emergency, the Power Branch, which was the predecessor of the Office of War Utilities, was confronted with the extremely and important difficult task of developing good working relationships with the electric utilities, both public and private, and with other agencies of the government. We were then a relatively new organization and the men of the industry quite naturally had their fingers crossed. During that critical period, ELECTRICAL WORLD helped us immeasurably by its comprehensive and accurate reporting of our activities and by its editorial leadership. Without the wide public understanding in industry of our methods and objectives, we should have been severely handicapped.

I would like to say also that in my opinion ELECTRICAL WORLD has served the electrical industry in an unusual degree as a unifying force. While it is true that there are many associations of utilities, national and regional, and many associations of professional engineers who are interested in utility practice, there is no single forum for the exchange of facts and ideas about the electric power industry that can compare with ELECTRICAL WORLD.

For these reasons I want again to express on behalf of the entire staff of the Office of War Utilities our thanks for the great job that has been accomplished by this publication during the war.

Sincerely,
Edward Falck, Director
Office of War Utilities

WASHINGTON COMMENT

By R. N. LARKIN, Washington Correspondent

Effect of Atomic Energy on Utility Business

EFFECTS of the atomic conquest on thinking with regard to the future of the electric power business have shown up in Washington recently in two divergent statements.

According to information which seems reliable, one large utility has made some discreet inquiry of regulatory bodies regarding the attitude they might take toward the depreciation, over the next ten years, of a substantial portion of the company's plant. At this writing, the inquiry seems not to have been directed to the Federal Power Commission.

Supplemental, Not Superseding

The echoes of President Truman's statement announcing the atomic attack on Hiroshima had hardly died away before some people were writing off, figuratively speaking, coal, oil and electric power securities. Others, perhaps wishfully, saw in the event the Gotterdammerung of federal hydro developments. Perhaps it will be so although the reasonable prospects now add up to the contrary, bringing up the second statement. This was delivered by Dr. J. R. Oppenheimer, director of the New Mexico laboratories of the Manhattan District and a key figure in the development of nuclear fission and its control. Testifying before Senate subcommittees, Dr. Oppenheimer said in part:

"I think that an installation to provide 500,000 or 1,000,000 kw. in usable form, let us say for electric energy, is not very far off. One could prove that it is possible. One could build one and make it work, but to fit it into a natural, living economy and find out where plants of this kind were preferable to water power and to coal, to find out just what it was good for in the practical life of the world may take a long time. If the government were interested in establishing, let us say, an installation showing that you could make the thing work, I don't see any reason why in five years or less it should not be going along."

Sen. Warren G. Magnuson, Washington Democrat, asked Dr. Oppenheimer whether "you believe that commercial uses of atomic energy can be fused gradually and slowly into our economic life so that there will be no disruption, such as has been pointed out (by Magnuson)."

"Of course," replied Dr. Oppenheimer, "but I think there is more to it than that. There have seldom been great inventions which have not supplemented rather than replaced existing machinery. You may look at the incandescent lamp. I think there was some worry that the introduction of fluorescent lighting would put the incandescent lamp manufacturers out of business. There are more incandescent lamps made today than ever before, and more fluorescent as well. With power it will be the same way. Human society depends on power. It is one of the most important ingredients of our wealth. The fact that there are new sources of power almost certainly will mean that we will use more power and use it in different ways rather than that we will give up drilling for petroleum and give up mining coal."

Appropriate Centers

Dr. Oppenheimer's comment about determining "where plants of this kind were preferable to water power and to coal" raises a question for both the government, which under pending legislation will have absolute control in the United States over atomic energy, and the electric power industry, which may well want to utilize it one day.

If it be granted that the use of atomic energy for power purposes will come gradually rather than all in a rush, who will do the broad planning on both technological and economic questions to determine where and why the first atomic power plants shall be installed—government or the industry? Before the war, the power business planned the location of new steam power facilities on the basis of where energy could be generated profitably. The federal government planned its hydro developments on a mixed basis, paying heed to necessity for water control and use, not forgetting political expediency. The war brought that to a halt four years ago, and during the war almost one-fifth of the central station capacity now in place was located by an extremely high-principled organization (OWU) which placed capacity on one basis only—where it could do the most to win the war.

Now that too has passed, as it should. But the question arises as to whether a similar control will return when atomic energy, under government license, begins to be utilized by the electric power business. Even today the Federal Power Commission has a practical veto on private hydro installations. Undoubtedly whatever federal commission ultimately licenses atomic energy for private use will have a similar authority.

Depreciation Issue Raised

The advent of the atomic age probably will have its effect on the electric and gas industries even before the first atomic power plants are built. In FPC's current natural gas hearings it has been suggested that rigorous conservation of gas may be a little ridiculous in view of the availability of atomic energy. FPC men anticipate that future rate cases will not close without the question being raised.

Until someone finds a practical way to utilize atomic energy as such in place of coal or oil, it seems a reasonable conclusion that investment in fuel generating equipment should not be written off immediately, although perhaps fuel storage and handling equipment and maybe boilers are in danger of obsolescence before their natural life span is complete. Certainly this would be true if we were to have atomic fuel in the next five to ten years. On this basis, rate cuts which imperil sound depreciation might be unjustified, although there are no indications that rate raises to allow for complete and quick depreciation are at present contemplated.

NEWS OF THE WEEK

REA's $550,000,000 Plans Bring Varied Opposition

Representatives of Co-op and Municipal Utilities Association Join Business-Managed Industry in Opposing Huge Appropriation to REA at Hearings on Lucas and Poage Bills before House Subcommittee

Opposition to the Rural Electrification Administration's $550,000,000 program for three post-war years of rural line building was laid before a House Interstate Commerce subcommittee last week by representatives of a co-operative, a municipal utilities association, and the privately owned electric power industry.

The hearings, believed to have been completed, were on the Lucas and Poage bills, the former of which passed the Senate last Spring with a rider divorcing REA from the Agriculture Department. Testimony before the House group was not concerned with REA's independence.

Grover C. Neff, president of the Wisconsin Power & Light Co., speaking for the Edison Electric Institute of which he is a director, told the subcommittee that REA can complete its share of the remaining rural line construction which is feasible with the $300,000,000 it had in appropriations and unexpended balances at the start of the preseut fiscal year. Virtual completion of the remaining line-building job is in sight in the next three years, Neff declared, adding it could be achieved by cooperation between REA and private companies.

REA's $300,000,000, he said, would enable the agency's cooperative borrowers to reach 700,000 farms in the next three years. During the same period, he went on, private companies expect to spend about $225,000,000 connecting 600,000 farms and an additional $36,000,000 connecting 320,000 additional rural non-farm customers.

Frank M. Wilkes, president of the Southwestern Gas & Electric Co., told the committee of numerous specific examples of what he termed "willful, careless and unnecessary expenditures" promoted by REA. Other company witnesses included H. L. Arnold, of the Southwestern Gas & Electric Co.; Henry B. Sargent, vice-president of the Mississippi Power & Light Co.; A. C. Inman, of the Idaho Power Co., and L. D. Stanley, of the Columbus & Southern Ohio Electric Co.

Preceding the company witnesses were C. H. Gelder, manager of the Dakota County Electric Cooperative, Farmington, Minn., and Lee M. Nelson, manager of Municipal Utilities, Rochester, Minn., speaking for the Minnesota Municipal Utilities Association. Both claimed that co-ops need protection from REA-sponsored projects which leave cooperatives with heavy debt burdens. In particular, they protested against extension of co-op-owned generating plants.

Appearance of all company witnesses except Neff was organized by P. L. Smith, president of the National Association of Electric Companies. The witnesses, Smith said, prepared their own material. Witnesses were chosen so as to give broad geographical representation. The idea was to give the committee specific examples of what companies believed to be improper activities of the REA program.

Neff told the committee that privately owned electric companies had not shirked the task of rural electrification in the decades following the inception of central station service and antedating REA. He pointed out that during the '20's, numerous miles of line were built and rural customers served. One problem which held down rural electrification then, he said, was the lack of devices by which farmers could utilize electricity. Most equipment then, he said, was built to be powered by gas engines or by animals. The industry, he went on, worked with the Farm Bureau Federation and land-grant colleges to develop electrical devices. One tool so developed, he said, was a small hammer mill powered by a 3-hp. motor.

Between 1930 and 1935, Neff pointed out, few companies were able to finance extensive rural construction and fewer farmers were able to buy electric service. With the improvement of economic conditions and the advent of REA, Neff said, the companies went side by side with REA in extending service, a practice they intend to continue now that restrictions on materials have ceased.

REA Speeded Electrification

Neff emphasized that he felt REA had done a good job in rural electrification and that he considered that REA competition after 1935 helped speed the job. He added that if after two years experience, it develops that REA has insufficient funds to do its job, he would appear before the committee and support a request for additional funds. The job has been done to a point, he added, where REA and the privately owned industry should "team up" and forget whatever bitterness has arisen.

Ralph E. Gale, general sales manager of the Idaho Power Co., told the subcommittee that his company had engaged actively in rural electrification in its Southern Idaho-Eastern Oregon territory since 1916, and in 1940, between 85 and 90 percent of all farms with occupied dwellings valued at more than $500 were served. This, he pointed out, is about twice the national average.

Henry Sargent, vice-president and general manager of the Missippi Power & Light Co., told the subcommittee that "the cause of rural electrification will be better served if real cooperation between REA and the private utilities can be achieved."

CONSUMERS POWER CO. HIT BY STRIKE—Candles replaced electric lights at the collection booth of the Consumers Power Co. office in Muskegon, Mich., during the strike last week. In the right panel are the members of the Utility Workers Council, Congress of Industrial Organizations, as they met at Saginaw, Mich., to discuss strike strategy. Left to right are Emerson T. Campbell, secretary-treasurer; Benjamin J. Otto, vice-president; Garland Sanders, president; Orno L. Knowles, vice-president; and Fred Hundersmarck, vice-president

Consumers Power Strike Ended by 13-Cent Raise

A four-day strike of 22 locals of the Michigan Utility Workers Council, Congress of Industrial Organizations, which cut off power only briefly in Muskegon but was a constant threat to over 2,000,000 customers of Consumers Power Co., ended Monday morning.

Settlement was reached during a 13-hour conference between Gov. Harry F. Kelly of Michigan and union members. Workers will get a 13-cents an hour increase, and a clause provides for "further determination" should a change develop in the nation's wage pattern.

The strike was called by the union after a majority of the 22 locals rejected an original 13 cents an hour raise advocated by Governor Kelly's mediation commission. The union men wanted 30 cents an hour more; Consumers Power offered 10 cents.

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Holding Company Hearings in Washington Recessed

Public hearings looking to possible changes in the Holding Company Act of 1935 to prevent capitalization of taxes and losses in government revenue from sales of utility properties got underway this week before the Boren sub-committee of the House Interstate Commerce Committee but were recessed after a single session.

Internal Revenue officials, appearing by request at the initial session, conceded they had no data showing actual or potential tax losses resulting from sales of holding company properties into public ownership which brought from Chairman Lyle Boren, Oklahoma Democrat, the statement that he was "amazed and disappointed" and a request that the officials "get the answers" and come back.

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House Group Files Adverse Report on MVA Measure

In the House, the full Irrigation and Reclamation Committee this week filed an adverse report on the Missouri Valley Authority bill, sending the measure to the Agriculture Committee for consideration of the farm aspects of the proposal. No date for hearings by this committee have been announced.

The Irrigation and Reclamation Committee listed 13 specific objections to the measure, including assertions that the bill fails to protect local autonomy, would involve surrender of legislative powers to government corporations, would create an autocracy, and would duplicate the comprehensive program for development of the basin through projects already authorized for construction by the Army Engineers and the Bureau of Reclamation.

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Senate Group Exempts FPC

The Senate Judiciary Committee this week reported legislation authorizing the President to reshuffle federal agencies, but only after writing into the House-approved measure a provision placing the Federal Power Commission and a half-dozen other agencies aloof from executive transfer. The House had exempted the Securities and Exchange Commission but not FPC.

$801,000 Valuation Placed on Coast Utility Property

A market value of $801,000 for the Portland General Electric Co.'s properties in and near Vancouver, Wash., which Public Utilities District No. 1 of Clark County, Wash., is seeking to acquire, was set by the jury that heard condemnation proceedings in the United States district court at Tacoma, Wash., last week. The amount includes both market value and severance damages.

P.U.D. and company witnesses varied their estimates on the market value of the property from $640,000 plus $54,000 severance damages, set by R. L. Baldwin of Kansas City, testifying for the P.U.D., to $1,200,000 plus $250,000 severance damages, set by Jay Samuel Hartt, Chicago consulting engineer, a company witness. P.U.D. attorneys called the verdict "very fair."

In a second suit, which also will be heard at Tacoma, the P.U.D. seeks to acquire the Clark County properties of the Northwestern Electric Co. of Portland, Ore.

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Power from Dnieprostroi Expected in Autumn, 1946

Indications are that the Dnieprostroi hydroelectric plant in Russia will be back in operation by autumn of 1946 with its capacity raised from 558,000 kw. to 660,000 kw.

The 26 wrecked piers of the 760-meter-long dam have been repaired, and automobile and pedestrian traffic via a tunnel inside the dam was restarted some time ago. Testing of models for the 100,000-hp. units began in August.

War-time Problems Get Attention of E.E.I. Group

Agenda of Transmission and Distribution Committee Includes Emergency Service Restoration, Stormproofing, Service to Large Appliances, Economical Loading—Many Solutions Suggested at Cleveland Meeting

Regeared and reactivated for comprehensive and penetrative attack on the problems which have emerged during the war, the transmission and distribution committee of Edison Electric Institute met in Cleveland on October 15 and 16.

Chairman L. R. Gaty, Philadelphia Electric Co., set the new tempo by enumerating for the agenda such timely topics as emergency service restoration, stormproofing, service to large domestic appliances, economical loading, and construction economies. Contributions to most of these items were made at the current meeting. Among items urged by Gaty were (1) development of a yardstick for measuring service reliability in terms of the customers' wants, (2) consideration of mobile radio and (3) of aerial cable.

New Aerial Cable Described

Sixteen companies reported using aerial cable, of which eleven use messenger and five self-supporting cable. E. V. Sayles, Consumers Power Co., discerned little concern on the matter of making live connections or of sectionalization; shielding seems to be preferred, although a drawback to live handling. G. S. Van Antwerp, Philadelphia Electric Co., advocated a critical attitude of why?, where? and how? in approaching the decision on aerial cable. T. F. Peterson, American Steel & Wire Co., described a new design in which the bare messenger is surrounded by the spiraled conductors, each of which carries a shielding of semi-conducting Neoprene. Jack Sherwood described a "Three-E" design of disconnect-plug outdoor junction box to facilitate live tapping or sectionalization. Several discussors sensed no reason why aerial should not be worked alive by linemen with rubber gloves.

Toward improving primary performance, H. P. Seelye, Detroit Edison Co., mentioned avoidance of trees, ring primaries, secondary banking, bare wire (arcs clear themselves and outages drop to less than one-tenth), aerial cable, a judicious number of sectionalizing buses and quick fault clearing.

Experience with four experimental stretches of buried rural cable in the Batavia area was deemed by J. H. Milbyer, Buffalo Niagara Electric Corp., to have been such as to have lead to the decision that it is not feasible for growing-load areas.

R. E. Jones, Hydro-Electric Power Commission of Ontario, on the contrary, said the commission has had some 150 miles in rural service since 1922, and he said he would like to see more of it.

Surge testing of cable and joints was viewed as in its infancy by both G. B. McCabe, Detroit Edison Co., and E. W. Osterreich, Duquesne Light Co., in presenting papers on the subject. Cable failures attributable to lightning had precipitated both studies; over 16 years Pittsburgh found that percentages of 22 kv. failures occurring during lightning disturbances were—joint failures 47.5 percent; terminal failures, 29 percent; cable failures 6.5 percent. Osterreich recited tests of 244 samples for surface flashover but deductions prove inconclusive. Both companies will prosecute their studies.

Much commendation was given J. W. Anderson, Philadelphia Electric Co., for his prompt success in getting joint EEI-ACRMA committee agreement to limit 115-volt motor starting currents to 40 amperes for drives of the infrequently (manually) started cooling equipments. Sentiment favored unification of utility rules to conform with the agreed limit.

Protector tubes on a 33-kv. wood-pole line with ground resistance, ranging from 220 to 4,775 ohms, were reported by M. H. Pratt, Central New York Power Corp., as having prevented many outages. His admonition to check the gap settings after warping of arms was seconded by G. E. Dean, Public Service Electric & Gas Co., Newark, who preferred cocking the tubes to establish the desired gap rather than using "cat whiskers" for the purpose.

Belief was expressed that manufacturers are remiss in street lighting developments; the novel fluorescent whiteway system in Spartanburg, S. C., was mentioned as an index of courageous departure from the conventional. E. W. Osterreich questioned whether standardization in this field was entirely advantageous in view of habitual community demand for "something different," not necessarily better; he feels mast arms are taboo. E. K. Karcher, New York Power & Light Corp., reported experimenting with a series circuit fed from 2.4 kv. through capacitors.

FLORIDA BOOSTER—A. W. Higgins, president of the Florida Power Corp., predicts a great industrial future for Florida at a meeting last week in New York attended by bankers and underwriters who will bid shortly on a new Florida Power stock issue

Fewer Transformer Ratings Asked

Elimination of the 1½, 7½, 37½, 75 and 200-kva. transformers was proposed by O. B. Falls, General Electric Co., as a means of reducing both manufacturer and utility stocks, and bringing quicker shipments, ultimate lower cost, less kw. and kw.-hr. loss (the latter if load factors are better than some 25 to 30 percent). H. A. Enos, American Gas & Electric Service Corp., interpreted the presentation as indicating the economic merit of underloading transformers, rather than the overloading which has become general practice; he held out for the 1½ kva. unit, saying that it could be replaced when necessary without pecuniary loss and that many rural areas may never need more than 1½ kva. G. S. Van Antwerp demurred on the proposed elimination of the 75-kva. because it falls at the transition point for pole and platform mounting in Philadelphia practice.

Prospective broadening of the species of timber for poles to include jack pine, western white pine, sugar pine, white fir, hemlock, larch, spruce, tamarack and others under the ASA standardization requested by OPA evoked some adverse comment, partly because the war emergency soon will have expired. Fiber strengths as proposed are on a different basis from those set in regulations for conventional species, and this was decried.

Useful Lessons Attributed to Southeast Power Pool

Electrical Equipment Committee of E.E.I. Hears That Experience in Administering Pool Advanced Art of Controlling Load Swings and Tie-Line Interchanges—Developments in Germany and England Explained

Experience in instrumenting and administering the 1,000-mile-diameter Southeast Power Pool has measurably advanced the art of controlling load swings and tie-line interchanges. This was forcefully and lucidly explained by S. B. Morehouse, Leeds and Northrup Co., in an afternoon symposium of the two-day meeting of the electrical equipment committee of Edison Electric Institute in Cleveland, October 17 and 18.

Interconnections the country over need, he said, the same will to participate and accommodate as marked the pool operation once the elements of the intricate problem were identified and acknowledged. Until comparable recognition is given to the factors involved in smaller as well as comparable aggregations it will not be possible to achieve the potential economies of smoothed operation and incremental costs.

Principal Impediments Named

Morehouse named, as two principal impediments, (1) the habitual manual changes in loading made out of all relation to area load requirements at the moment and (2) uncoordinated governor action. Other factors that were sensed and handled were lack of regulating capacity and range, lack of regulator response, and lack of biasing capability.

Speaking more specifically of routine operating experience, E. E. George, Ebasco Services, said performances of load control and telemetering equipment were satisfactory but voice carrier not entirely so. Dispatching communication needs to function reliably without adjustment during storms; sets should be installed indoors. Rates of response in base load plants are too slow to meet tie-line or frequency regulating requirements. Some companies, George said, have learned that it is better to share load changes despite different incremental costs. Just why tuning and matching adjustments apparently change with 60-cycle ampere-loading of steel-core conductors was suggested as a matter for research.

Procedures in controlling swings and interchanges on two other interconnection areas were detailed by S. M. Hamill, Cincinnati Gas & Electric Co., and T. H. Mawson, Commonwealth & Southern Corp.

A major deduction from the symposium was that as bias interchange control expands there will be less emphasis on a central frequency-control station and on operation guided dominantly by incremental costs.

Developments found in Germany by the official group were detailed by H. J. Scholz and C. F. Wagner. (These will appear shortly in Electrical World.) Reentry of oil has restored the oil breaker in England as a competitor of the erstwhile dominant air breaker, reported A. V. De Beech. In the humid, foggy atmosphere the whole surface of multi unit insulators is being given conducting glaze. Oil in breakers on electric furnaces is filtered continuously. Mexico has 50,000 customers connected without meters due to inability to import them in quantity. A Swiss manufacturer announced readiness to export 380-kv. breakers if desired.

De Beech followed with a paper on the evolution of the "1½ breaker" scheme into the several variations of the ring bus employed in the Ontario Hydro-Electric Power Commission stations as recently designed or expanded. Several have two rings with parallel bridges between. W. R. Way said Shawinigan Water & Power Co. had eliminated several rings and reverted to single-bus schemes. E. H. Snyder, Public Service Electric & Gas Co., Newark, said ring buses do conserve investment but are confusing to operators.

J. O. Leslie, Gilbert Associates, in demonstrating the flaws in station design which lead to operating fatalities, urged that consideration be given to a post-war program of rehabilitation to remove lurking hazards to both casual and habituated employes. He emphasized the merits of the use of rope-offs, barricades and of cleared bays for oil breakers as well as the importance of de-energizing instrument and control transformers that can contribute feedbacks.

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5 Quebec Co-ops Formed

Five more cooperatives have been formed in the Province of Quebec. Headquarters will be established at Gaspe, St. Ambroise de Chicoutimi, St. Liboire de Bagot, Matapedia, and Beaurivage.

Government to Sell Lake Charles Plant

Riverside Power Plant No. 2, the 35,000-kw. steam generating station for the Lake Charles, La., government magnesium plant which was the subject of a sharp wartime squabble over location last Spring, has been offered for sale.

Known officially as Plancor 264, the steam station is being offered for sale separately from the magnesium plant. The station has never been completed and operated. Included in the offer for sale is a Foster-Wheeler boiler rated at 420,000 pounds per hour at 925 psi. and 825 deg. F, together with a superheater, controls, etc., an Allis-Chalmers 35,000-kw., 13.8 kv., three-phase, 60 cycle, 3600 rpm. turbo-generator, with wiring, pumps, compressors, etc., a steel-frame concrete housing, crane, conveyor, hoist, etc., and 24 mercury arc rectifiers.

One known bid already in the hands of the Reconstruction Finance Corporation, which is disposing of the property, is from Gulf States Utilities Co., of Beaumont, Tex.

Unit Was Planned for Arkansas

The Riverside No. 2 unit was first planned for installation at the government's Lake Catherine, Ark., aluminum plant but was switched to Lake Charles before delivery. Easing of magnesium requirements during the war resulted in halting construction before the unit was ready for operation. Last Spring, to meet a load situation in the Southwest, the Office of War Utilities recommended transferring the unit back to Lake Catherine, but the proposal was withdrawn after V-E Day over the objections of the Interior Department, which hoped to acquire the unit as part of its Southwestern Power Administration system.

No decision has been made by the Government regarding disposition of the remainder of the Lake Charles magnesium works, including a 15,000-kw. and seven 7,500-kw., units which provided energy for the plant during the period that it was operated.

Meanwhile, the Navy Department has announced that it intends to turn over to RFC for disposal as surplus property 2,500 small generator sets valued at over three billion dollars which were built to power advance overseas bases that never had to be built because of the sudden end of the war, and 14,000 transformers ranging in size from ½ to 75 kva, acquired for shipboard use on vessels no longer needed. No itemized description or appraisal of the property has yet been made.

T & D and Sales Groups Will Join in Load Building

Transmission and Distribution Committee of Pennsylvania Electric Association Discusses Handling of Heavier Domestic Loads—Simplification of Hardware, Work on Hot Lines Are Other Topics on Program

Cooperation of transmission and distribution department with other company departments, work on hot lines, testing of racks, fractional horsepower motor starting currents, coordination of loads, ratings and protection of distribution circuits, treatment of southern pine poles, lightning field investigations, transformer ratings, insulators, and breaker bushings and insulation were among the subjects discussed by the Pennsylvania Electric Association Transmission and Distribution Committee in Reading, on October 18 and 19.

A. J. Althouse, assistant general manager, Metropolitan Edison Co. and a member of P.E.A. executive committee, stated that the T. and D. departments would necessarily work closer with sales personnel in obtaining and serving most economically the new and heavier domestic loads. Reduced rates, he continued, are possible only by increasing sales and reducing costs. The latter calls for the judicious use of more automatic equipment, careful future system planning, and eliminating antiquated equipment as soon as economically feasible.

Load Coordination Discussed

In discussing coordination of loads, ratings, and protection of distribution circuits John M. Lakas, Pennsylvania Electric Co., drew these conclusions: (1) where load pickup is a problem of major proportions, sectionalizing of the circuit by manual or automatic means, seems to offer the best solution, (2) economy of investment indicates that circuits should be loaded to the limit of their rating, thereby accentuating the pickup problem, (3) a combination of relay schemes, pole type reclosures, and fuses is required in most cases to provide reasonably satisfactory circuit protection, (4) oil-filled reclosures are better than fuses in that experience shows greater freedom from faulty operation, and better continuity of experience, and (5) there is need for oil-filled reclosures of greater continuous rating and rupturing capacity than are now available.

That non-uniformity on point of load application and on rate of load application makes it practically impossible to evaluate secondary rack test data was one of the points brought out during the discussion on simplification of hardware. J. W. Anderson, Philadelphia Electric Co., reported that agreement had been reached between the E.E.I. T. & D. committee and the room cooler and refrigeration manufacturers on fractional horsepower motor starting currents; top limit on 115-volt motor will be 40 amp. and all drawing over 40 amp. will be 230 volts.

In clearing right-of-way with power equipment one company reports that 127 acres had been cleared in 1944 with a D-8 Caterpillar and a curved blade set square with the power unit at a cost of $75 per acre.

A porcelain crossarm which does not necessitate pins or insulators in supporting the conductor was shown by R. G. Bellezza, president of Locke Insulator Corp. He stated that insulator supplies would be tight for some time. Manufacturers are desirous of cooperating with operating companies in reducing numbers and types of insulators, and NEMA standard types will cover about 90 percent of applications, he said.

"An analysis of the electric fields produced by the 'initial streamers' of direct strokes to an unprotected line indicates that surge voltages of appreciable magnitude can be induced on a conductor as much as 50 to 250 microseconds before the actual stroke contact," stated G. D. McCann, transmission engineer from Westinghouse Electric Corp., "and these may reach potentials ranging from 100 to 1,000 kv. This is confirmed," he said, "by a detailed climbing inspection of an unprotected 33-kv. wood pole line and by 49 recorded cases of flashover. About 40 percent of the recorded cases of flashover caused a tripout; and although about 85 percent produced a multiphase flashover, only 20 percent resulted in a sustained multiphase fault. The concentration of power follow at guyed poles shows that they determine to a great extent the tripout performance of such lines.

J. A. Vaughan, research engineer, Southern Wood Preserving Co., said that a few southern pine treating plants equip pole trimming machines with a spray mechanism which covers the freshly machined surfaces with a toxic solution as the pole emerges from the machine to sterilize the pole and for a time prevent possible infection by spores which may fall on the poles.

E. Fritz, Pennsylvania Water & Power Co., showed a movie in which the line crew changed two strings of insulators and replaced a single insulator in two separate strings on a hot 230-kv. line utilizing standard 66-kv. hot line tools with the necessary clearance obtained by lashing tools together. This was an emergency job resulting from rifle damaged insulators and was successfully completed under direction of E. Hansson of Pennsylvania Water & Power, and T. Bowen of Kearney Corp.

THREE AWARDS—Public Service Co. of Colorado has been thrice honored for its radio program, "High Lights of the Rockies," broadcast from KLZ, Denver. The award at the left is a citation from City College of New York for "the most effective institutional, commercial program developed by a radio station for 1944;" in the center, a plaque from "Variety" magazine for sponsoring the outstanding program of the year; on the right, the Advertising Club of Denver identifying the program as "the ad of the year" for the second successive time

President Requests Added Appropriations

$128,475,000 Additional Asked for Army Engineers—Bureau of Reclamation Seeks $93,367,000

Deficiency appropriations to permit full-scale resumption of work on the Central Valley Power and Irrigation project and on several other sections of the Interior Department's power program were sent to Congress this week by President Truman.

In all, the President asked for supplemental funds totaling $128,475,000 for the U. S. Army Engineers for authorized flood control and navigation projects and $93,367,000 for the Bureau of Reclamation. The major power item in this first post-war government construction bite is a proposed $18,500,000 additional for the Central Valley project, to boost funds available for this development during fiscal 1946 to $34,500,000.

Of the requested new funds for Central Valley, $6,065,000 is earmarked for construction of the second and third 230-kv. transmission lines from Shasta Dam to complete the loop from the power stations to the Delta-Mendota Canal and to Central Valley's load centers, and a 115-kv. line from Keswick Dam via Sacramento to the irrigation pumping load center. Additional funds also are earmarked in the program for completion of power installations at Shasta and Keswick, including the transfer of the two Shasta units used at Grand Coulee during the war, and the erection of transmission switchyards for the entire project.

50 Percent Complete in 1946

The acceleration proposed for Central Valley will bring the development to slightly more than 50 percent completion by the end of fiscal 1946, with $196,000,000 expended and $188,000,000 more needed to finish the job.

Other large chunks in the President's post-war power construction request of Congress include $10,000,000 for Davis Dam; $11,000,000 for Grand Coulee, which includes installation of additional generating units to replace the Shasta units and to complete Coulee's right powerhouse; $7,683,000 for the Colorado-Big Thompson project; $1,925,000 for Anderson Ranch dam; and $1,500,000 for the Hungry Horse project in Montana, an adjunct of the Columbia River development.

Also included in the request is $6,325,000 for initiation of construction of the Boysen, Kortes and Angostura dams in the Missouri Valley basin and a transmission line from Fort Peck to Garrison dam project for use of the Army Engineers there, and ultimate use as part of the power transmission grid in that area.

The $128,000,000 plan for the Corps of Engineers will allow the resumption of several projects begun before the war but halted, and the beginning of construction on numerous other projects. Sixteen Army projects containing power were listed recently by the War Department as capable of being started this fall if funds are made available.

The President's requests were referred to the Appropriations Committee in the House for study. Date of hearings has not been set.

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Omaha District Organizes

Directors of the newly formed Omaha Public Power District (ELECTRICAL WORLD, September 29, Page 91) have organized with J. M. Harding as president; Charles D. Saunders, vice-president; and Karl Brown, secretary.

MEETINGS

Previously Listed

International Association of Electrical Inspectors—Southern Section, Baker Hotel, Dallas, Texas, October 29-31. A. M. Miller, secretary, 219 Governor St., Richmond 19, Va.

National Electrical Contractors Association—Annual meeting, Carter Hotel, Cleveland, Ohio, October 29-31. C. J. Harder, national secretary, 633 Investment Bldg., 15th and K. Sts., N. W., Washington, D. C.

Pennsylvania Electric Association—Communications committee, Roosevelt Hotel, Pittsburgh, Pa., November 1-2; W. H. Lambert, chairman, Pennsylvania Electric Co., Johnstown, Pa. Systems operation committee, Penn Harris Hotel, Harrisburg, Pa., November 8-9; A. R. Deck, chairman, Metropolitan Edison Co., 412 Washington St., Reading, Pa.

International Association of Electrical Leagues—Annual conference, Morrison Hotel, Chicago, Ill., November 1-3. O. C. Small, secretary, 155 E. 44th St., New York 17, N. Y.

Oklahoma Utilities Association—Electric Light & Power Division, Mayo Hotel, Tulsa, Okla., November 8. Kate A. Niblack, secretary, 625-626 Biltmore Hotel, Oklahoma City, Okla.

New Jersey Utilities Association—Annual meeting, Seaview Country Club, Absecon, N. J., November 16-17. Harry Bacharach, executive director, Atlantic City, N. J.

American Society of Mechanical Engineers—Annual meeting, Hotel Pennsylvania, New York, N. Y., week of November 25. Ernest Hartford, executive assistant secretary, 29 W. 39th St., New York 18, N. Y.

National Association of Railroad and Utilities Commissioners—National meeting, Deauville Hotel, Miami Beach, Fla., December 4-7. Ben Smart, secretary, 7411 New Post Office Bldg., Washington, D. C.

Southeastern Electric Exchange—Commercial Section, Atlanta Biltmore Hotel, Atlanta, Ga., December 5-7. J. W. Talley, executive secretary, 303 Haas-Howell Bldg., Atlanta 1, Ga.

Pacific Coast Electrical Association—Joint meeting of Business Development and Operating Economic sections, Hotel Californian, Fresno, Calif., December 7-8. V. W. Hartley, managing director, 601 W. 5th St., Los Angeles 13, Calif.

Rate Approval Puts Contracts into Effect

By authorizing the Pacific Gas & Electric Co. to establish a new rate schedule, the California Railroad Commission last week (October 16) automatically put into effect nine contracts between the private utility and northern California municipalities and companies, potential customers of the Bureau of Reclamation (ELECTRICAL WORLD, September 22, Page 9).

The new P-31 schedule, devised by the P. G. & E. to meet advance competitive rate offers on Shasta Dam power by the Bureau of Reclamation, is available to all customers served under the P-6 schedule who will sign a five-year contract. Average rate reduction amounts to 9.8 percent.

Suspended by the Railroad Commission August 27 for investigation, the new rate is effective retroactive to that date. Five-year service contracts embodying the schedule had been accepted by Alameda, Biggs, Gridley, Lodi, Palo Alto, Redding, Santa Clara, Bay Point Light & Power Co. and Vallejo Electric Light & Power Co. prior to the investigation.

Although the reduced P. G. & E. rate still is higher than prices asked by the Bureau when it offered Shasta power to several of the municipalities, it was worked out to prevent possible loss of customers to the government agency. The Bureau as yet has not succeeded in obtaining funds for transmission lines to permit direct delivery of Shasta power, and the Railroad Commission emphasized in its decision approving the new P. G. & E. rates that "no cost studies of the Shasta project have been made available to the public and no evidence thereon was presented at the proceedings."

In approving the rate and authorizing the contracts as "not unreasonable", the Commission nevertheless registered its disapproval of contracts in general, pointing out "this Commission has for many years taken the position that utilities should not require a contract as a condition precedent to obtaining service except under special circumstances."

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Texas Strikers Freed

Charges against three former employees of the Lower Colorado River Authority of injuring property during the recent strike were dismissed last week by a justice of the peace at Austin, Tex., when no one appeared against them.

Pacific Gas & Electric Co. Planning $49,000,000 Issue

Following an SEC decision last week removing the Pacific Gas & Electric Co. from Holding Company Act jurisdiction on grounds it can no longer be considered a subsidiary of North American Co., the California power utility was planning to complete this month marketing of a $49,000,000 refunding bond issue.

SEC's decision was made on application of the P.G. & E. and supercedes the commission's 1941 order establishing the subsidiary status of the utility. North American recently disposed of a large amount of P.G. & E. common and now owns only 5.24 per cent.

P.G. & E. is now subject solely to regulation by the California Railroad Commission. The State body recently ordered the company to call for competitive bidding (ELECTRICAL WORLD, October 13, Page 120) in the issue of series N 3 percent refunding bonds that will replace $49,000,000 of series I bonds.

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OPA Places New Prices on All Electric Conductors

Office of Price Administration has issued a new price regulation, to become effective October 29, which will include on its pricing lists every type of wire used for conducting electricity.

The new regulation will be known as Maximum Price Regulation 82. It is a revision of Revised Price Schedule 82, which priced only copper, copper-clad and copper-alloy wire.

Cable accessories and portable "trouble lamps" are not included in the new regulation, having been transferred to MPR 136. Purpose of the new regulation is to simplify pricing methods. These methods will be based on prices in effect on base dates, which are October 15, 1941, for copper wire and March 31, 1942, for conductors containing no copper.

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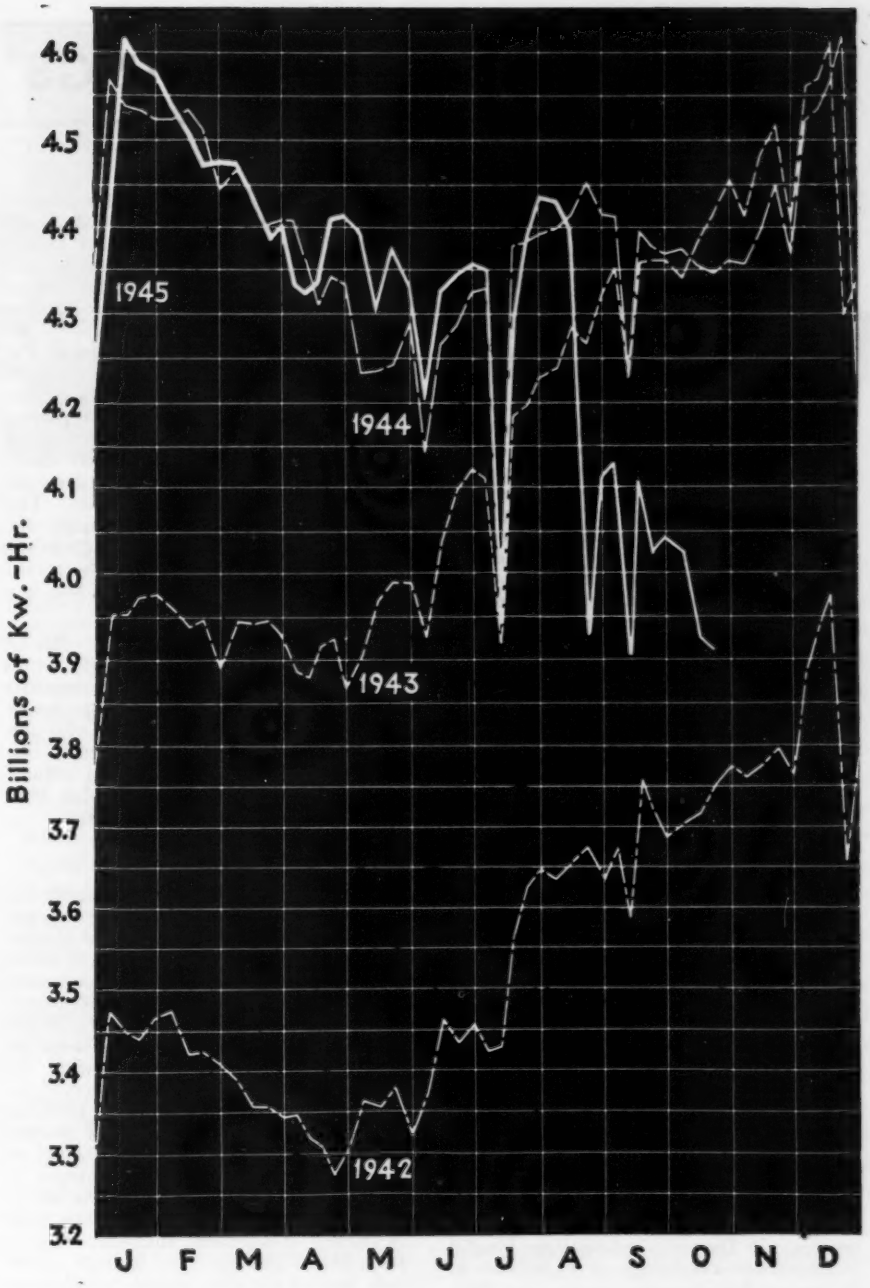
Wage Increase Granted

Portland General Electric Co. and Northwestern Electric Co. have signed new agreements with their employees who are members of the International Brotherhood of Electrical Workers granting them a wage increase of 15 percent. The contract with the former company is for six months, with the latter for one year.

Under the new scale, laborers receive $1 an hour, journeymen $1.62, and foremen $2.18.



Output Curve Moves Downward Again

The electric output curve continued on the downward trend during the week ended October 20, 1945, according to figures released by the Edison Electric Institute. The amount of electrical energy distributed by the light and power industry totaled 3,914,738,000 kw.-hr., compared with 3,934,394,000 kw.-hr. during the preceding week. During the week ended October 21, 1944, the amount of electrical energy distributed amounted to 4,345,352,000 kw.-hr., this year's figure representing a decrease of 9.9 percent.

The losses, which six of the seven major geographical regions of the country reported under last year, were not substantially changed from the preceding week.

Weekly Output Millions Kw.-Hr.

1945		1944		1943	
Oct. 20	3,915	Oct. 21	4,345	Oct. 23	4,415
Oct. 13	3,934	Oct. 14	4,355	Oct. 16	4,382
Oct. 6	4,028	Oct. 7	4,375	Oct. 9	4,342
Sept. 29	4,039	Sept. 30	4,366	Oct. 2	4,359
Sept. 22	4,019	Sept. 23	4,377	Sept. 25	4,360
Sept. 15	4,106	Sept. 16	4,395	Sept. 18	4,359
Sept. 8	3,909	Sept. 9	4,228	Sept. 11	4,229
Sept. 1	4,137	Sept. 2	4,415	Sept. 4	4,351
Aug. 25	4,116	Aug. 26	4,418	Aug. 28	4,322
Aug. 18	3,939	Aug. 19	4,451	Aug. 21	4,265
Aug. 11	4,395	Aug. 12	4,415	Aug. 14	4,288
Aug. 4	4,432	Aug. 5	4,399	Aug. 7	4,241

Percent Change from Previous Year

	Week Ending		
	Oct. 20	Oct. 13	Oct. 6
New England	— 5.3	— 7.4	— 3.1
Mid Atlantic	— 4.7	— 4.7	— 3.9
Central Industrial	— 12.8	— 12.8	— 11.4
West Central	— 1.6	— 1.2	— 1.0
Southern States	— 15.3	— 12.9	— 11.1
Rocky Mountain	+ 4.6	+ 3.9	+ 1.6
Pacific Coast	— 6.8	— 7.2	— 6.0
Total United States	— 9.9	— 9.6	— 7.9

SEC DECISIONS—HEARINGS

The Securities and Exchange Commission recently issued a series of orders affecting electric utility companies.

MINNESOTA UTILITIES CO. proposed sale of all its electric and steam-heating properties to Northern States Power Co. for $625,000 subject to closing adjustments has been approved. Minnesota Utilities Co. is a wholly-owned subsidiary of American Utilities Service Corp. Proceeds of the sale will be used in part by Minnesota to discharge existing obligations, including a $185,000 note indebtedness to its parent. The balance will be distributed to American Utilities as holder of all of Minnesota's stock, after which Minnesota will be dissolved. American will devote the proceeds of the liquidation of its subsidiary to reduction of its debt.

UNITED PUBLIC UTILITIES CORP. proposal to sell to Montana-Dakota Utilities Co. its investment in Dakota Public Service Co. and Knife River Coal Mining Co., subsidiaries of United, has been approved by the commission. United proposes to use $3,750,000 of the proceeds to prepay its 2 percent note in the principal amount of $3,750,000, due June 30, 1950, owing to Bankers Trust Co. of New York. The commission granted the request of United for an exemption from competitive bidding with respect to the sale of the securities involved, and reserved jurisdiction over the use by United of the balance of the proceeds.

COLUMBIA GAS & ELECTRIC CORP. and its subsidiary, Dayton (Ohio) Power & Light Co., have obtained approval of the SEC for proposed program, calling for the issue and sale by Dayton of $28,850,000 of first mortgage bonds and Dayton's purchase of Columbia's common stock holdings and indebtedness of the Miami (Ohio) Development Co. The purchase price for the Miami Company is $606,603. Proceeds from the issue and sale of bonds will be used to redeem all Dayton's outstanding bonded indebtedness—consisting of $1,337,000 of 3¼ percent first mortgage bonds, due 1962, and $23,256,000 of 3 percent first mortgage bonds, due 1970. As part of the program, Columbia will make a $2,000,000 cash contribution to Dayton. Dayton will redeem $2,100,000 of short-term bank notes from treasury cash.

CINCINNATI GAS & ELECTRIC CO. action in accepting the bid of an investment banking group headed jointly by Morgan, Stanley & Co. and W. E. Hutton & Co., for $45.5 million first mortgage bonds due 1975, and 270,000 shares of its preferred stock has been cleared by SEC. The group's "basket" bid was 100.3391 for the bonds with a 2¾ percent coupon, and 106, less compensation of $1.72 a share for the preferred stock, naming a 4 percent dividend rate. The commission in its order said that after considering the record, including the objections of H. L. Stuart, president of Halsey Stuart & Co., to the acceptance of the combination bid, it found no basis for adverse action. Public offering followed SEC approval.

PENNSYLVANIA POWER CO. and its parent, Ohio Edison's, joint proposal covering a general financing program for Pennsylvania Power has been approved. The program contemplates the issuance and sale under competitive bidding of $9,793,000 of first mortgage bonds, due 1975, proceeds from the sale of which would be used to refund $8,193,000 of outstanding 3½ percent and 4 percent bonds, to construct a new 35,000 kw. turbo-generator at New Castle, Pa., and for additional transmission facilities. Pennsylvania also proposes to issue not more than 42,000 shares of 4.25 percent stock, $100 par value, to be offered in exchange for the outstanding 42,000 shares of $5 preferred stock on a share-for-share basis, plus a dividend adjustment. This issue was exempted from competitive bidding by the commission. Jurisdiction was reserved by the commission over the results of the competitive bidding on the new bonds.

NORTHERN STATES POWER CO. (Minn.) has obtained approval of the SEC for its proposal to issue and sell at competitive bidding $75,000,000 of first mortgage bonds, due 1975. Proceeds will be used, with general funds, to redeem the presently outstanding $75,000,000 of first and refunding 3½ percent mortgage bonds, due 1967, at 104¼ percent plus accrued interest.

Applications Filed

LONG ISLAND LIGHTING CO. has applied to the SEC for authority to call for redemption on December 27 its 3¾ percent sinking fund debentures, due May 1, 1956, of which $10,000,000 principal amount were issued. There is now outstanding $7,510,000 principal amount of the debentures, $2,490,000 being held in the sinking fund. Under the provisions of the indenture securing the debentures, sixty days' prior notice of redemption must be given. The premium to be paid upon redemption is 2¾ percent of principal. To effect the retirement of the debentures the company proposes to issue three promissory notes in the aggregate principal amount of $7,000,000, bearing interest at 2 percent annually, and maturing Dec. 27, 1955. The balance of the funds needed for this purpose would come from the company's treasury. The company stated that retirement of the debentures will result in a reduction of approximately $142,000 annually in its interest charges on bonded debt, subject to adjustment for Federal income taxes.

MAINE PUBLIC SERVICE CO., and its subsidiary, Maine & New Brunswick Electrical Power Co., Ltd., have filed applications for exemption from the provisions of the Holding Company Act. Maine & New Brunswick seeks the exemption on the ground that it is not an operating utility company in the United States, all of its properties being situated in the province of New Brunswick, Canada. Maine Public Service Co. seeks an exemption from the act (except such provisions as are applicable to it as a subsidiary of Consolidated Electric & Gas Co.) on the ground that its operations do not extend beyond the State of Maine.

LAKE SUPERIOR DISTRICT POWER CO., Ashland, Wis., has filed a registration statement, covering $5,600,000 principal amount of first mortgage, Series A, 3 percent bonds, dated October 1, 1945, and due October 1, 1975. Lake Superior will use the proceeds together with general funds of the company to redeem $5,600,000 principal amount of first mortgage bonds, Series A, 3½ percent, due Oct. 1, 1966, at 105, plus accrued interest.

Hearing Scheduled

NOVEMBER 13: Opening of hearings on the plan of Engineers Public Service Co. for divestment of its interests in Gulf States Utilities Co. and El Paso Electric Co., retirement of its preferred stock and related matters.

UTILITY REPORTS

	Net Income 1945	1944
*American Gas & Electric and subs.	$12,550,454	$11,871,405
*California Oregon Power	1,031,931	1,324,626
†Central Maine Power	3,105,860	3,213,535
†Connecticut Light & Power	3,907,490	3,821,529
†Electric Bond & Share and subs.	3,042,126	4,992,572
†Idaho Power	1,428,550	1,401,528
*Mountain States Power	653,485	668,805
‡National Power & Light and subs.	4,167,053	3,918,744
†Public Service New Hampshire	1,444,177	1,326,887
*Puget Sound Power & Light and subs.	4,500,879	5,214,742
*Southern Colorado Power	316,915	376,568
†Texas Electric Service	1,922,694	1,375,675
†Texas Power & Light	2,738,028	2,504,960

‡Twelve months ended July 31.
*Twelve months ended August 31.
†Twelve months ended September 30.

Taxes on Privately Owned Utilities Drop in Wisconsin

Of the $269,060,444 in taxes levied and collected by the state of Wisconsin for the fiscal year ended, June 30, 1945, privately owned electric utilities paid 2.934 percent or $7,895,111 and rural electric cooperatives paid .030 percent or $79,741, the state department of taxation announced in September.

For the privately owned companies the figures were slightly lower than in 1944 when they paid 3.112 percent of the states revenues or $8,394,708. The co-ops that year paid .025 percent or $67,953.

Of the public utilities listed by the taxation department, the privately owned companies in 1945 returned to the state $811,600 in school taxes, $4,320,222 in local taxes, $1,579,022 in county taxes, and $1,184,267 in state taxes. The co-ops contributed $33,282 in school taxes, $33,282 in local taxes, $11,747 in county taxes, and $1,430 in state taxes.

Municipal Plant Unwanted

Cherokee, Iowa, residents recently voted 1,288 to 396 against erecting a municipal power plant and 1,335 to 369 to renew the franchise of the Iowa Public Service Co. for ten years.

HOW

DESIGN · CONSTRUCT · OPERATE · MAINTAIN

Prefabricated Forms Speed Turbine Erection

H. E. DEARDORFF
Planning Engineer
The Dayton Power & Light Co., Dayton, Ohio

Prefabrication of turbo-generator foundation forms in sections coded for rapid assembly the moment space in the plant was cleared, was a tremendous factor in speeding turbine erection in 1944 when Dayton Power & Light Co. was racing to install urgently needed generating capacity at Miller's Ford station.

Installation of a new 3,600-rpm. 30,000-kw. unit at this station in the space occupied by an old 1,800-rpm. 12,500-kw. unit required considerable rerouting of piping and relocating of equipment in the turbine-room basement. To meet the pressing need for added generating capacity, the construction schedule called for completion of the replacement job in 12 months; with the added requirement that the old unit must operate as long as possible, a situation tending to slow down construction.

WPB approval placed the unit on the manufacturer's schedule in December, 1943. Construction started in March and the new unit was in operation for trial on December 29, 1944. Twelve months from authorization to operation! The technique of prefabricating the foundation forms was a considerable factor in making this possible.

Assembled in Yard

Forms were entirely prefabricated and preassembled in the yard outside the station. They were erected on eight concrete pads two feet thick spaced according to the plan of the eight foundation columns just as if they were being built in the turbine room basement. Iron rings in the pads served as anchors for guy wires inside the forms.

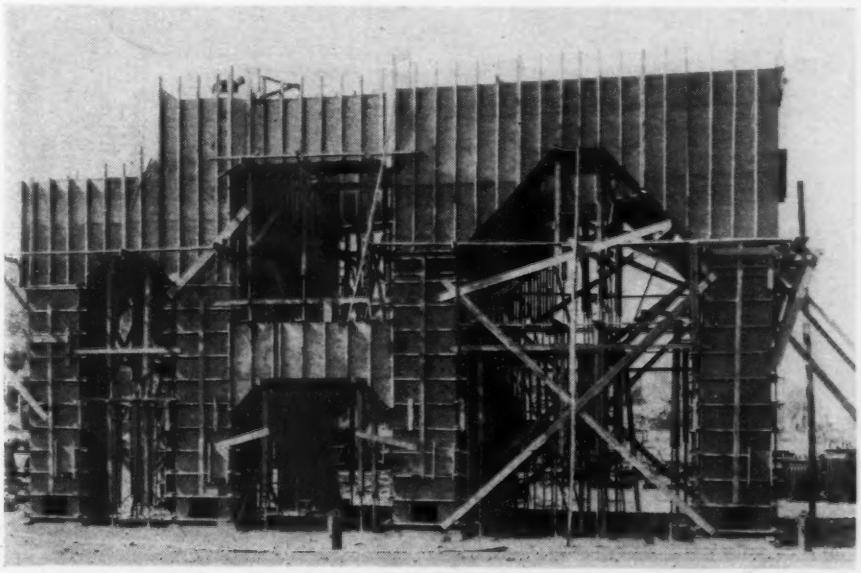
By building forms in the yard, work was started long before the basement site could be cleared for construction in place. Work could be done with the minimum of manpower since it could proceed at leisure with plenty of working space and light and no interference. An average of four carpenters and two laborers with a peak of six and two was enough.

Forms were ready as soon as basement space available. This contrasts with the usual mad scramble when forms are built by men working at high speed in cramped space amid interference from other operations.

Forms were of $\frac{3}{4}$-in. plywood with 2-in. by 4-in. and 2-in. by 6-in. bracing. A jig in the form of a bench was used in building column sections, holding the 2-in. by 4-in. bracing members while plywood sheets were nailed to them. Thus column sections were of uniform construction and formed perfect matches at the external corners where they were fastened together. Holes were drilled in the plywood sheets to receive tie rods after final assembly.

Double-headed nails were used where joints had to be broken during dismantling. Only sufficient nailing was used to keep the form from collapsing in the wind. A few shores and diagonal braces helped.

Fire protection during construction was furnished by pump tank water extinguishers and a $2\frac{1}{2}$-in. fire



TURBINE FOUNDATION FORM prefabricated in station yard while clearing of site progressed inside, saved many weeks time in erection of 30,000-kw. unit at Miller's Ford station. Picture shows form just prior to dismantling

hose. Hot dry weather during the erection and proximity of a railroad made these precautions necessary.

Tack-Welded Reinforcement

Reinforcing steel was assembled outdoors in beam and column sections by electric tack welding. Enough welding was done so that sections could be handled by a sling from the boom of a locomotive crane.

At the apropriate time the knocked-down form and prefabricated reinforcing sections were hauled into the building and erected by eight to ten carpenters and four to six laborers, with six to eight iron workers in 12 working days of ten hours each. This includes bracing, shoring, etc.

Cost and time required for the prefabricated foundation compares interestingly with conventionally built form installed two years previous. The former job took ten weeks to complete while the present job required only three weeks inside the building, plus the period of prefabrication outside. Prefabrication work was intermittent and extended over ten weeks. In all, 9,300 man-hours were expended on the older foundation—10,400 man-hours on the new one; an increase of 11.85 percent. Overtime was paid for 516 man-hours on the old job—2,860 man-hours on the new job. During the interim, however, average wage rates rose materially. The net result was a 40 percent increase in labor cost of the latter job.

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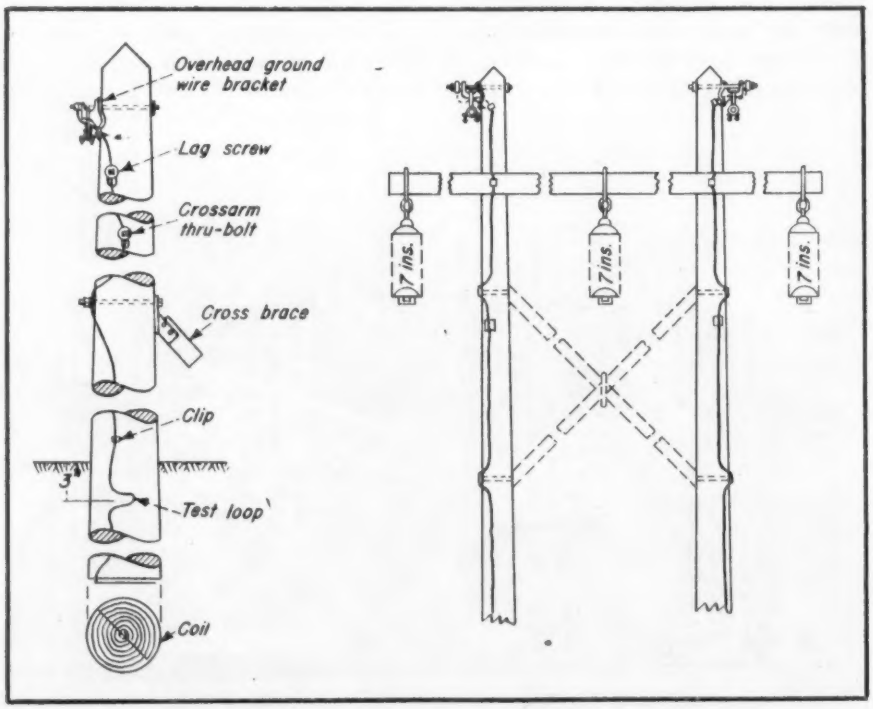
Ground Wire Details from Pole Top to Butt

Grounding details recently approved as standard by the New York State Electric & Gas Corp., Binghamton, N. Y., for all unguyed structures with overhead static wire provide for (1) keeping all metallic bolts and screws at ground potential, and (2) a ground test loop. Also a coil is used under the pole butt in lieu of a ground rod.

The ground wire is installed as follows:

1. Bracket bolt is first set up tight.
2. The down ground wire is looped around this bolt and fastened with a second nut. A lock nut is also used to prevent "back-off."
3. Ground wire is looped around a lag screw which is placed about 18 in. below the wire bracket. (This is a special lag screw which has two nuts; one for setting the screw firmly in the pole and the second for maintaining a tight connection between ground wire and lag screw even though the lag screw should loosen from the pole.)
4. Ground wire is looped around crossarm through-bolt and fastened between two nuts.
5. If cross braces are used, it is looped around each bolt and likewise held firm between two nuts.
6. A 4-in. test loop is provided approximately 3 in. below the ground line.
7. An eight-turn coil is fastened to the pole butt with wire staples.
8. Kearney ground wire clips are used to fasten the ground wire to the pole at 4-ft. intervals.

All pole line hardware is thereby securely interconnected so that no loose connections are likely to occur between it and the groundwire. This minimizes radio interference and prevents pole splintering during lightning discharges.



POLE LINE HARDWARE tied together and maintained at ground potential by ground wire interconnection. Installation of this type of grounding is shown at right on a 114-kv. line on 2-pole, H-frame construction

•

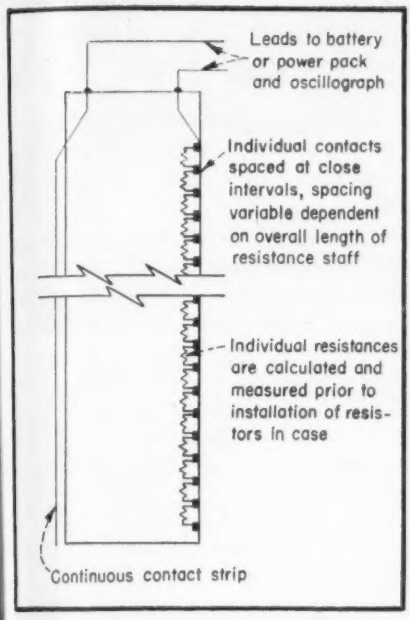
Instrument Measures Height of Waves

EUGENE H. WOODMAN
Chief, Electrical and Mechanical Section
U. S. Waterways Experiment Station
Vicksburg, Miss.

A wave-height measuring apparatus, having obvious applications in hydro-electric power station operation is among the instruments developed to solve the modern hydraulics and soils mechanics problems encountered in hydraulic model studies of the Mississippi River, being conducted by the Corps of Engineers, War Department, at the U. S. Waterways Experiment Station near Vicksburg, Miss.

Water level variations ranging from 10 ft. to less than 0.01 ft. have been measured with various versions of this wave-height measuring device. No difficulty is foreseen in extending this range in either direction.

Essentially the device consists of a vertical staff containing a series of individual contacts on one face, covering the vertical range of water movement expected, and a continuous contact on the opposite face. Small ½-watt resistors are interconnected between the individual contacts on the face of the staff case. They can be

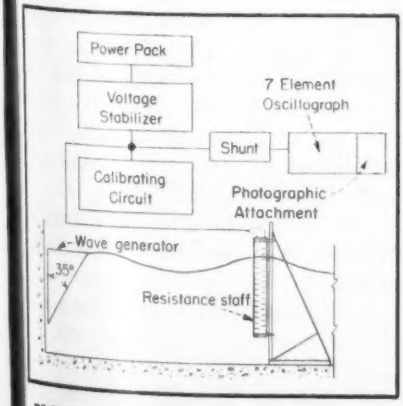

Leads to battery or power pack and oscillograph
Individual contacts spaced at close intervals, spacing variable dependent on overall length of resistance staff
Individual resistances are calculated and measured prior to installation of resistors in case
Continuous contact strip

SCHEMATIC DIAGRAM of resistance staff for wave height measurements

mounted on a crossarm above high water where close contact spacing is necessary, however.

In principle the device uses a water path to complete an electrical circuit between two points. Resistance of the electrical circuit thus established is made to vary in inverse proportion with variations in the water surface elevation by suitable calculations of the individual resistors between contacts. Thus when a *constant* d.c. voltage is impressed across terminals of the resistance staff resulting current changes will correspond directly with changes in water surface elevation or wave height.

It is obvious that this device is voltage sensitive in regard to calibration and that a *constant* d.c. voltage must be impressed on terminals of the resistance staff. One of the difficulties in first applications of this device was the frequent calibration

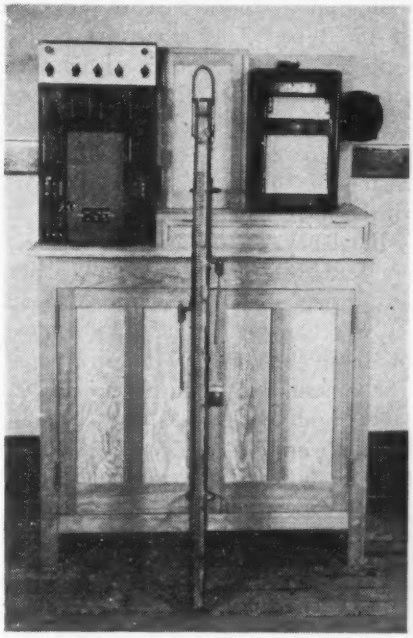


BLOCK DIAGRAM of complete wave height measuring apparatus

necessitated by fluctuations in battery potential. Operation from a. c. lines through the usual rectifier and filters was indicated but output irregularities were encountered as well as traces of 60 and 120 cycle voltages and their harmonics even with an oversized double-section filter. The device was also affected by a.c. supply transients.

These disturbances could have been ignored with an indicating or recording meter but with oscillographic recording refinements in voltage supply were imperative. Oscillographic recording is employed because of the the short wave periods (1 to 3 sec.) of the model waves. For waves of longer period a recording meter could be used with equivalent results.

The circuit finally evolved was an adaptation of the voltage stabilizer



EXPERIMENTAL resistance staff, relay circuit for control of record taking intervals, and recording milliammeter installed in experimental station lake

controlled by a thermionic pentode described by Evans* operated in conjunction with a gaseous voltage regulator tube rated at 90 volts. Such a circuit provides an output voltage of extreme stability, completely protected from a. c. transients and long time surges. It produces a straight trace on the oscillogram indistinguishable from d. c. battery trace.

A 3-ft. resistance staff used in the experiment station lake is shown. Here a recording milliammeter was used with relays to control the interval and length of records taken. Triggers on the side of the resistance staff were interconnected with the relay circuit so that storm waves not in coincidence with the set intervals of wave recording would not be missed. Intervals of recording were reduced as wave height exceeded values for which the triggers were set.

Investigations at the Waterway Experiment Station are under the supervision of Brig. Gen. M. C. Tyler, president, Mississippi River Commission. Director of the Experiment Station is Gerard H. Matthes, head engineer.

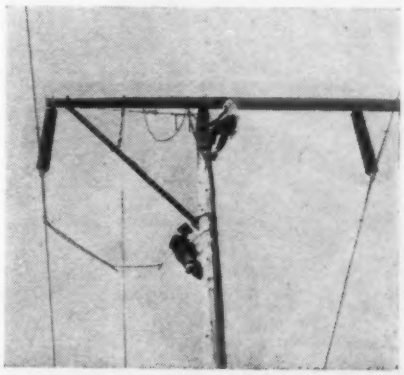
* Review of Scientific Instruments, October 1934.

•

Temporary Arm Brace Used for Safety

Feeling that there was an element of danger in linemen working on the 11-ft. overhang of 30-ft. wood spar crossarms on a 230-kv. transmission line, W. L. Carter, line foreman of Pacific Gas & Electric Co., worked out the temporary brace arrangement illustrated. The upper end of the wood brace is provided with a "U" shaped strap iron saddle to fit the round arm and is prevented from sliding out the arm by a rope cinched to the top of the pole as shown. Lower end of the brace is chained to the pole, making a rigid support.

The line in question is the U. S. Bureau of Reclamation 100-mi., 230-kv. wood pole line from Shasta to Oroville, Calif., which Pacific Gas & Electric is under contract to operate and maintain by virtue of terms of a power agreement with the government.



LINEMEN making repairs on end of overhanging wood spar arm are protected from possible arm failure by temporary brace shown at left

Vacuum Break Lessens Cavitation

B. E. ELLSWORTH
Electrical Engineer
Nebraska Public Power System

The more efficient the turbine and draft tube, the more likely they are to be bothered with cavitation.

For reducing or eliminating cavitation the application of a coat of 25/20 stainless steel to an installed runner means overhead welding and is not a particularly pleasant job. An alternative is to set the turbine low so the tail-water elevation is the same as the elevation of the runner, or higher. However, high water in the draft tube has its disadvantages, one of which is the difficulty of inspection of the tube and runner. Another is that of subjecting the lower turbine bearing to water pressure from beneath when the turbine is idle or running at light load.

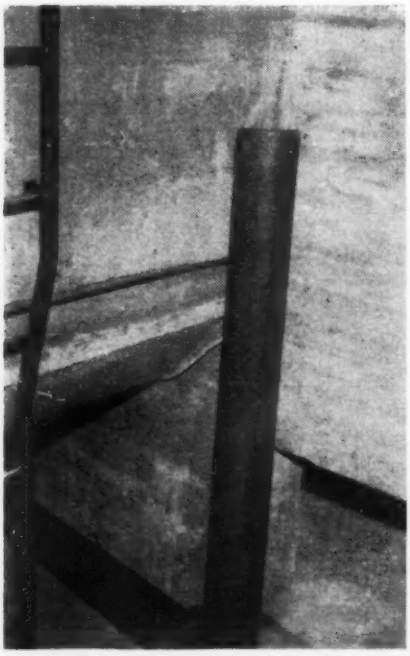
In a satisfactory method used at one of Nebraska's hydro plants the units were set high with respect to the tail-water elevation, in fact 5 ft. higher than intended due to the unknown elevation of the tail water when the plant was installed.

The "vacuum" on the machines ran as high as 15 in. of mercury at maximum gate opening and the turbine was designed for 8½-in. maximum. Cavitation developed rapidly. Stainless steel was welded over the runner where accessible and thin stainless steel plates were welded onto the inside of the draft tubes.

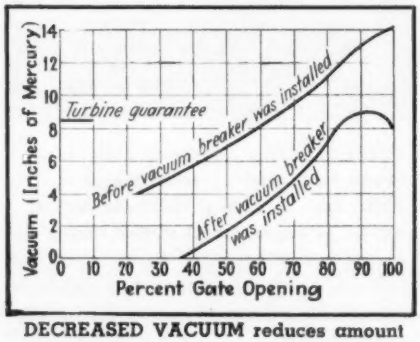
Cavitation did not oblige by occurring only in accessible places where welding could be done. It started to appear high up between the vanes so that it became necessary to take extreme action. The high efficiency of the unit was not of particular importance; so it was proposed to install a dam in the tailrace high enough to raise the tail water 5 ft. and thus reduce the vacuum. There were a number of drawbacks to this scheme.

The same result was accomplished by installing a large vacuum breaker in the draft tube. A 6-in. steel pipe was run through the side of the draft tube about 4 ft. below the runner and was extended to the center of the tube. An elbow was placed on this pipe and turned down. The pipe was well supported by braces to the sides of the tube. The pipe was vented to the atmosphere outside of the draft tube through a 6-in. riser. A view of the riser and the elbow are shown. If the pipe ended elsewhere than the center of the draft tube, excessive vibration resulted.

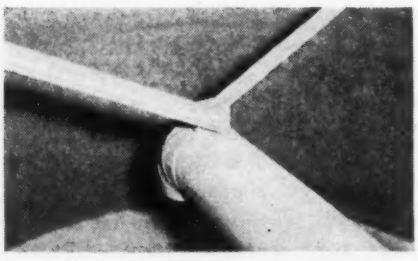
Efficiency of the machine was decreased over the theoretical 2½ percent expected, and the overload capacity was likewise reduced but neither of these was a serious drawback. The vacuum was reduced about 5 in. (see graph) and this lower vacuum should result in a very great reduction in the cavitation.



VACUUM BREAKER vented to atmosphere by 6-in. riser



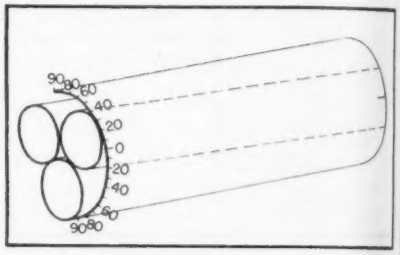
DECREASED VACUUM reduces amount of cavitation



SIX-INCH ELBOW in draft tube acts as breaker of vacuum

Cable-Lay Determined by Home-Made Device

In making a so-called factory splice, i.e., one in which the connectors of a 3-conductor cable are staggered axially and are 120 degrees apart radially, and are inserted to require no diameter increase in the insulation, over that of the original, it is necessary to determine the lay of the cable.



CABLE-LAY determining device is cylindrical in shape with zero designation on both ends and degree offset calibrations on one end

The length of lead sheath that must be cut to make the "factory splice" is thereby ascertained.

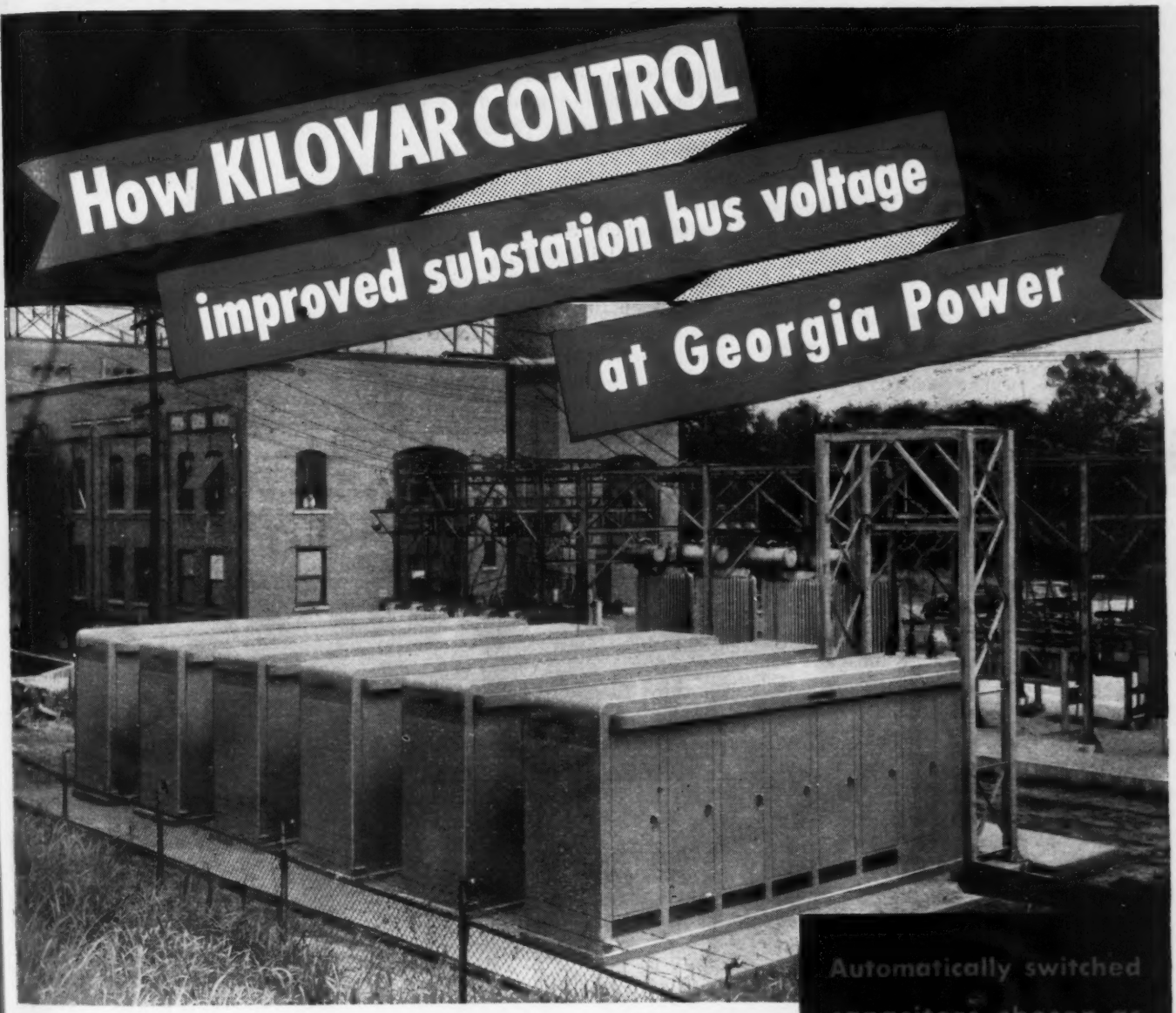
Louis E. Phillips of the Philadelphia Electric Co. has made a device which determines this lay easily, quickly and positively. It is made of either fiber or metal, is 12 in. long and bent into a half cylinder, the diameter of which is equal to the diameter of the 3-conductor cable with the lead sheath and the belt insulation removed. One end of the device is calibrated in degrees on the outside circumference and the other end has a zero mark exactly opposite the zero mark on the calibrated end.

Lead sheath and belt insulation are removed from 15 in. of the cable preparatory to making the splice. Lay can be determined at this stage. Center points are marked on one conductor in two places longitudinally 12 in. apart. The device is then placed over the conductor so that the zero marks on the device coincide with one of these center marks. Degrees offset of the center marked conductor at the other (calibrated) end of the device indicates the angular travel of that conductor in the 12-in. stretch.

The complete lay has a radial travel of 360 degrees. Therefore, 360 divided by this number of degrees offset multiplied by 12 will determine the lay in inches.

Example—The offset indicated by

How KILOVAR CONTROL improved substation bus voltage at Georgia Power



Automatically switched capacitors chosen as most flexible and economical method

THE Georgia Power Company found it desirable to control the bus voltage at its 110,000- to 13,800-volt Augusta substation to prevent widely varying voltage levels between periods of full load and light load. Six of our attractively styled Pyranol capacitor equipments were chosen for the job. Each equipment is rated 2520 kva.

The stepdown transformers at the substation were set on the proper high-voltage tap to give the desired low-voltage bus voltage at light loads. As the voltage drops with increasing loads, the 15,120-kva capacitor bank is automatically connected to the circuit in six equal steps, supplying kilovars to the system and keeping the bus voltage up.

As expanding loads increase the minimum demand at Augusta, there will be less difference in voltage between light load and full load. The transformer tap setting can be changed, and some of the six capacitor equipments can be easily moved to other points of the system that in the future may need reinforcement.

Thus, by selecting capacitors for this installation, Georgia Power not only improved present operating conditions but also provided a flexible source of kilovars for future needs.

We will be glad to help you analyze your kilovar requirements and estimate the benefits of Pyranol capacitor banks on *your* system. Ask for Publication GEA-4225. ***Apparatus Dept., General Electric Company, Schenectady 5, N. Y.***

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GENERAL ELECTRIC

the device is 45 degrees. What is the lay?

$$\frac{360}{45} = 8$$

$$8 \times 12 = 96$$

Therefore, 96 in. is the lay of the conductor.

•

Reduces Transverse Strand Resistance

JULIAN ROGOFF
Assistant Chief Engineer
Burndy Engineering Co., New York

When connections are made in cable consisting of a large number of very small strands. The current passing from a cable to a connector travels from the inner strands of the cable through the contact surfaces of the strands to the outer strands; from the outer strands through the contact surfaces between these strands and the inner surface of the connector barrel and into the connector barrel. Therefore, the contact resistance between cable and connector consists not only of the resistance between the strands and the connector, but also of the resistance between and through the strands themselves. Copper cable has very low resistance between strands and current passes easily from strand to strand. On the other hand, each strand of aluminum cable is covered by a film of aluminum oxide, which has an insulating effect upon individual strands, thereby causing the cable to act substantially as if it were made up of a series of parallel conductors.

Burndy engineers have concluded from research that the most effective method of breaking down the transverse resistance in aluminum cable connectors was by the introduction of a compound comprised of zinc dust suspended in petrolatum jelly.

This compound, applied in the barrel of the connector, performs a triple function. First, it covers and protects the inner surface of the connector barrel after that surface has been treated to eliminate the oxide film thereon, and it prevents a new film from forming before the connector is installed on the cable. Second, and most important, when the cable is inserted into the barrel of the connector, and the compound is restrained from pushing out of the barrel, it is forced in between the strands. Subsequently, when the connector is indented onto the cable end, the particles of metallic zinc, coating each strand, break through the film of oxide and thereby provide numerous low resistance current paths from strand to strand and strand to connector. This effectively reduces the transverse resistance between strands in the cable connection. The third function of the compound is to inhibit and prevent the formation of oxides or other products of corrosion in the electrical connection after it has been made and is in actual service.

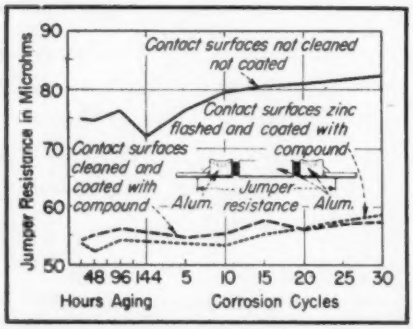

FIG. 1—Overall resistance in microhms of longitudinally indented connections to aluminum stranded conductor with and without zinc-dust compound

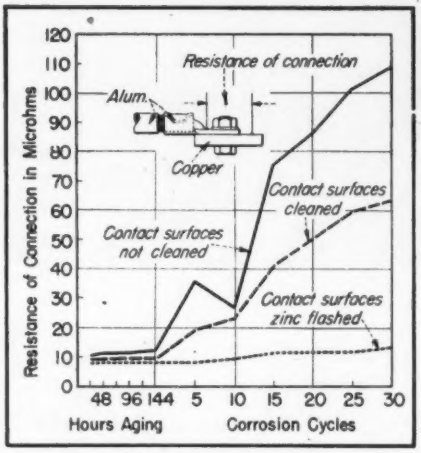

FIG. 2—Resistance of connection of aluminum lug connection to copper

Before the zinc-petrolatum compound is inserted into the connector barrel, it is necessary to remove the film of oxide on the inner surface of the barrel. This is accomplished by etching the surface chemically, then rinsing, and, with the surface still wet and protected from attack by the oxygen in the atmosphere, immersing into a bath which precipitates a zinc-flash on the aluminum surface. The zinc-flashed surface is then plated with zinc to provide a mechanically strong coating. The aluminum contact surface is thereby covered with a coating of low resistance metallic zinc that prevents formation of high resistance aluminum oxide.

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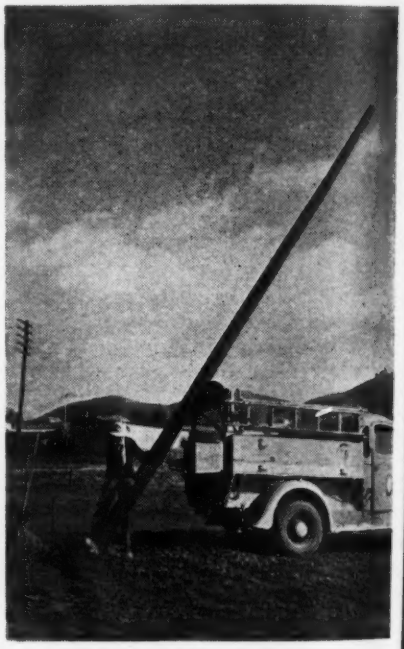
Two-Man Crew Sets Light Poles

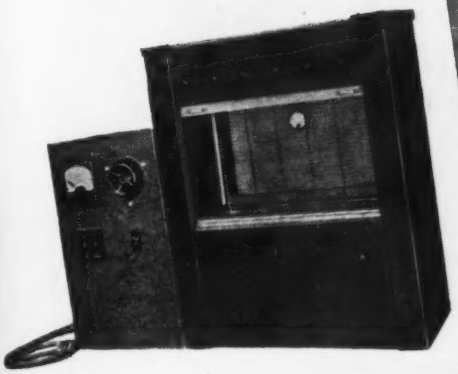
C. A. ROCHHOLZ
Engineer, California Electric Power Co., Riverside, Calif.



SETTING POLE with light service truck. Pole rides in flanged metal spool while being bucked-in to prevent slipping off rest on back of truck

Bucking-in poles with a light service truck is a method of setting poles often used by utilities in small districts where poles are light and manpower is limited. California Electric Power Co. has equipped its light service trucks with a special device for this purpose, as illustrated. This consists mainly of a flanged metal spool mounted in an elevated position at the rear of the truck. The spool and its axle are demountable so that they can be carried only when needed. Some companies mount a bracket on the cab of the truck so that the pole may be transported in a horizontal position, thus making it ready for setting with a minimum of men in the field. When poles are set in this manner it is, of course, necessary to well trench the hole to prevent the butt from kicking out, and to use a heel board in addition in many cases to protect the hole.

Some Time-saving Testers



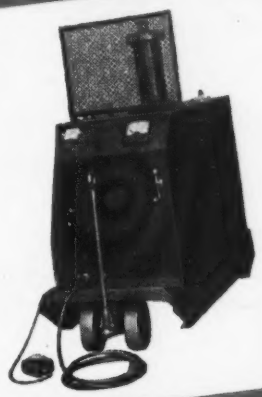
GLOVE TESTER -- 20,000 VOLTS A-C

A QUICK, SAFE WAY TO TEST RUBBER GLOVES

This glove tester consists of two sections which fit together as a unit: a glove testing cabinet, and a high-voltage a-c power supply (which can be used separately, if desired, for general-purpose testing).

The glove-testing compartment, which contains a water tank in the lower section, is provided with supports for simultaneous testing of six standard linemen's rubber gloves. Contact with the water inside the gloves is made by chains hanging from a high-voltage bus which is solidly supported on insulators. A milliammeter connected in the high-voltage circuit indicates the leakage current in a glove when one of the six control buttons at the top of the cabinet is pushed.

This set, which operates on 115 volts, 60 cycles, fully meets all requirements of the National Safety Council for this class of testing. For complete information, write for HB-5112, page 101.



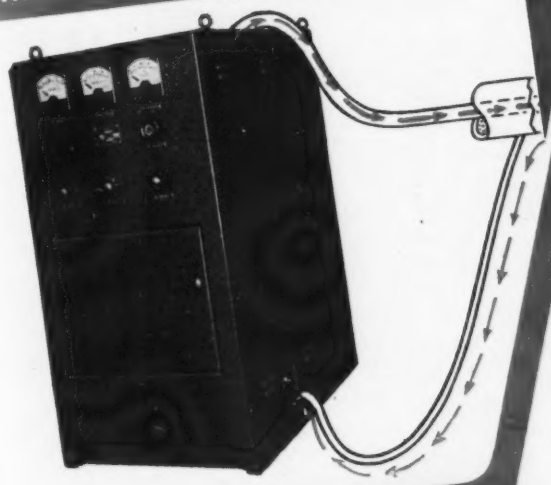
PORTABLE TEST SET -- 100,000 VOLTS A-C

MAKES IT EASY TO TEST HARD-TO-MOVE EQUIPMENT

This completely self-contained, sturdy, a-c equipment has a rating of 10 kva, making it suitable for testing large, high-voltage equipment such as transformers, circuit breakers, bushings, and short lengths of cable.

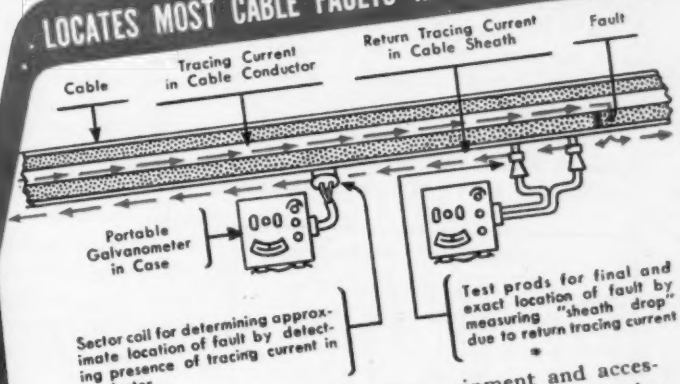
The voltmeter is highly accurate throughout the complete range up to 100,000 volts, at all loads and power factors, thus permitting precision measurements of the applied voltage.

Approximate dimensions are 5¾ by 2½ by 6 feet. Operates on 230 volts, 60 cycles. For safety, release of a floor switch, which must be held down during test, instantly de-energizes the set. For more information, ask for HB-5110, page 121.



D-C CABLE-FAULT SET

LOCATES MOST CABLE FAULTS IN LESS THAN 1 HOUR


Cable
Tracing Current in Cable Conductor
Return Tracing Current in Cable Sheath
Fault
Portable Galvanometer in Case
Sector coil for determining approximate location of fault by detecting presence of tracing current in conductor
Test prods for final and exact location of fault by measuring "sheath drop" due to return tracing current

This d-c set includes all the equipment and accessories required to locate faults quickly and accurately.

The set is used at the station, first to reduce fault resistance, then to transmit a d-c tracing current, which can be followed out along the cable with an exploring coil and galvanometer. Write for Bulletin GEA-3687B for complete data.

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BUY WAR BONDS

A METHOD FOR IDENTIFYING LEADS ON SWITCHGEAR WIRING DIAGRAMS

A. E. ANDERSON, Panel and Equipment Division, General Electric Co., Philadelphia, Pa.

Tracing of circuits is facilitated by a logical procedure of lead marking incorporated in wiring diagrams. The method of marking not only serves to identify the lead but also indicates the origin and destination of the lead, so that it is unnecessary to show individual wires but permits grouping them into "trunks."

Letters are assigned first to individual terminal boards and then to individual devices or logical groups thereof, in alphabetical order from left to right and from top, down. A few letters between terminal boards and devices remain unused, depending on the size of the equipment, to form a reserve for any possible addition of terminal boards later on. Capital letters "I" and "O" are eliminated. After all the letters of the alphabet have been used, double letters "AB", "AC", "AD", etc. are introduced.

Referring to Fig. 1 as an example, the terminal board is assigned the letter "A" and the devices lettered "C", "D", and "E". Each stud on a device is assigned a number from left to right and top to bottom. On simpler devices, such as indicating instruments and meters, the numbers may be omitted from the symbol.

However, on some devices, for manufacturing reasons, the stud identification is not in the above stated order; in these cases the stud numbers are indicated on the internal device diagram as shown in Fig. 2.

A lead connecting point No. 1 of terminal board "A" to stud No. 5 of overcurrent relay "E" is designated

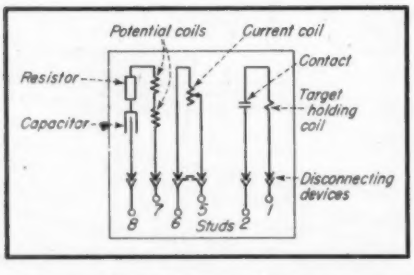


FIG. 2. Typical internal diagram (back view) of drawout type of device, type ICP directional ground relay

"A1E5", the terminal board letter and number always preceding the device letter and number. Similarly the lead connecting stud No. 1 of the ammeter "C" to stud No. 6 of the overcurrent relay

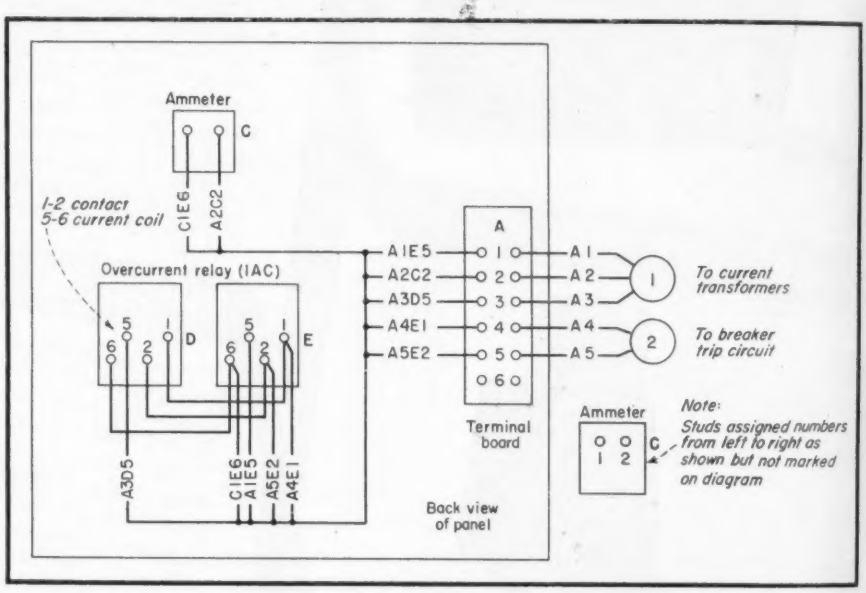


FIG. 1. Wiring diagram simplified, illustrates method of lead marking

"E" would be designated "C1E6", the letter and stud number of the device located higher on the panel preceding the letter and stud number of the device located lower on the panel. The advantage of this procedure is evident when tracing a connection having its origin at about the middle section of a more complicated panel, the lead designation giving the indication to either go up or down the panel for its destination thus eliminating about one half of the area covered by the entire panel diagram.

Jumpers

Short jumpers, such as between adjacent overcurrent relays "D" and "E" Fig. 1, need bear no lead marking. Leads connecting to indicating lamps associated with control switches bear the same letter as the control switch with an added letter "R" (red) or "G" (green). Fuses and resistors are also assigned individual identification letters.

Interconnections from one panel or unit to another are identified by adding panel or unit numbers to the lead combination. For example, a wire connecting from terminal point 3 of terminal board designated "X" of unit or panel No. 7 to terminal point No. 5 of terminal board designated "M" of unit or panel No. 8, would be marked "7X3-8M5."

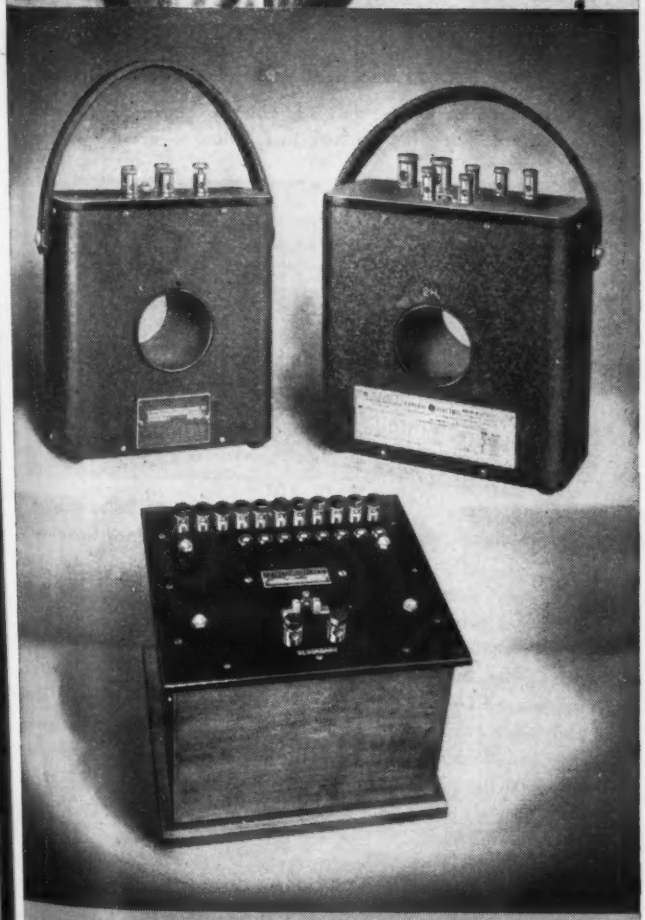
Temporary Identifications

Terminal boards introduced for shipping breaks of a structure too large to be handled as one complete unit are not given identification letters and are therefore not used as such for lead identification combinations, and furthermore, may not appear on the wiring diagram. Temporary identification is provided by means of tags, to facilitate reconnection in the field.

The method outlined for tracing out a circuit on the simple diagram of Fig. 1 also holds for more complicated diagrams. With the aid of the respective elementary diagram while tracing through circuits of the wiring diagram a marked proficiency in reading the diagrams will result and a better knowledge of circuits will follow.

Announcing 3 NEW Portable INSTRUMENT TRANSFORMERS

They're LIGHTWEIGHT
MULTIRANGE
ACCURATE



JP-2 JP-4 JP-3

FOR FIELD TESTING OR LABORATORY USE—Types JP-2 and JP-3. Their accuracy is class 0.3 with burdens B-0.1 to B-0.5 at 60 cycles. Having both the wound-primary and the through-window-type construction, they cover a range of 10 to 2500 amperes. A wide variety of ratings can be obtained by passing the conductor through the window two or more times.

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These three types are the latest additions to our line of portable instrument transformers. The complete line includes current transformers for ratings of 0.25 to 2500 amperes, and potential transformers for 240 to 4800 volts.

For further information on portable instrument transformers to meet your field or laboratory requirements, write to the nearest G-E office or to Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

*Trade-mark reg. U.S. Pat. Off.

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GENERAL ELECTRIC

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HOW TO RAISE SINGLE POLES WITH A FALLING-GIN

M. J. URNER, Assistant to Vice President, The Potomac Edison Co., Hagerstown, Md.

Faced with the problem of building 13 miles of 33-kv. line over terrain too difficult for either trucks or horses and with limited manpower, J. E. Grose, Potomac Edison Co.'s District Line Superintendent at Frostburg, Md., perfected methods for using a winch-equipped Caterpillar D-2 tractor and a gin pole in handling and erecting line poles.

FIG. 1—Poles have near ends chained to sled, locally known as a "log boat," are drawn by tractor to location in rough terrain. Subsequent illustrations show use of falling-gin in only open area along 13-mile distribution line

FIG. 2—Winch-equipped tractor beginning the pull for raising of line pole with crossarm attached. "Dead-man" prop for gin-pole has just fallen to ground

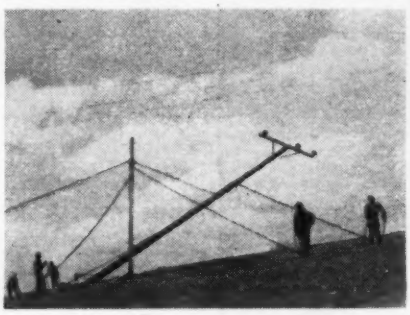

FIG. 3—Line pole partially raised; gin pole vertical. All men are in the clear

FIG. 4—Pole drops into the hole; cables are slack. Another crew does tamping

New distribution line follows the right-of-way of a 132-kv. steel tower line across the rugged Appalachians to a new fire brick manufacturing plant of Union Mining Co. near Grantsville, Md. Design consists of single-pole construction with pin-type insulators, Class 4 creosoted pine poles, 300-ft. spans, and No. 2 A.C.S.R. conductor.

Recalling published articles describing the "falling-gin" method of erecting large transmission line H-structures, the local Line Superintendent decided that if the principle could be used effectively for raising single poles with a tractor supplying the power, his manpower problem would be eased considerably.

An arrangement of gin-pole and cable was worked out which enabled an 8-man crew to erect an average of 25 poles with crossarms and insulators attached per 8-hr. working day. Two piking crews of 15 men each would be needed to erect as many poles (without crossarms and insulators) as were erected with the 8-man crew with the tractor in an average day. **Steps in pole raising operation are shown.**

Safety is one of the outstanding features of the falling-gin operation, particularly as compared to the piking method. With the falling-gin all men are in the clear when the pole is raised, and the only strenuous effort exerted is by the tractor. Approximately 350 poles were set with the falling-gin without a single lost-time accident.

As finally modified by field experience, the rig consists of a gin-pole 23 ft. long made by cutting back a 30-ft. Class 6 cedar pole, a sliding board made of a piece of 2 by 10-in. lumber 6 ft. long with a 2 by 6-in. cross piece, ½-in. steel winch cable of 8-ton capacity, and four ⅝-in. manila guy ropes. Two sets of guy hooks are provided on the gin pole for cable attachments. The top set is used for raising 50 and 55-ft. poles and a set 4 ft. lower is used for raising 40 and 45-ft. poles. The sliding board has a short piece of flexible cable run through holes in the top which is fastened to stakes to keep the board perpendicular.

The pole raising procedure begins when the line pole and gin-pole are put into position side by side on the ground with the butt of the line pole against the sliding board in the hole, and the butt of the gin-pole about 6 ft. from the pole hole. Two rope guys are then attached to the pole and two to the gin, and the four men who handle the guy ropes drive bars into the ground for snubbing anchors. Meanwhile the crossarm is being bolted on, and cables are being attached. The gin-pole is then propped up on a "dead-man" and the rig is ready for the tractor to do the heavy work. As the winch pulls the pole erect the men on the guy ropes keep down the side sway until the pole slides into the hole. The whole outfit then moves to the next location, leaving straightening up and tamping in for another gang to do.

The gin-pole will be used in combination with a derrick truck for locations inaccessible to the truck but within reach of its winch cable.

ANOTHER reason why G-E BALLASTS add reliability to your fluorescent fixtures

THESE ballast coils—picked at random from a production run—are identical. This is not a matter of chance.

These coils are automatically wound by a machine that predetermines the number of copper-wire turns for every coil layer, that spaces these turns exactly, and feeds in layer insulation at just the right instant. Constant tension is maintained on the coil wire as it feeds on to the specially constructed winding spool so that every finished coil is exact in size, smooth, compact, and evenly rectangular. No rounded sides, no "springy" layers.

Long lamp life; rated light output. This uniformity of coil design is one important reason why every G-E ballast has electrical characteristics perfectly matched with the lamp it is to operate—a "must" to assure long lamp life and rated light output.

Improved ballast life. Matched characteristics contribute, also, to uniformly long ballast life—prevent early burnouts. It is features like this that are responsible for the fact that more than one billion watts of fluorescent lighting are being satisfactorily operated today with G-E ballasts. More than 150 lighting equipment manufacturers rely on G.E. for all or part of their ballast requirements.

For complete data on G-E ballasts, ask for GEA-3293F. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

These ballast features help keep fixture users satisfied—they mean added profits for you

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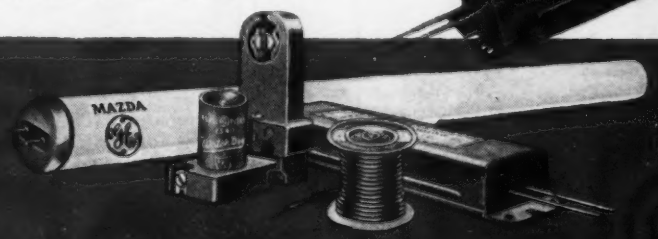

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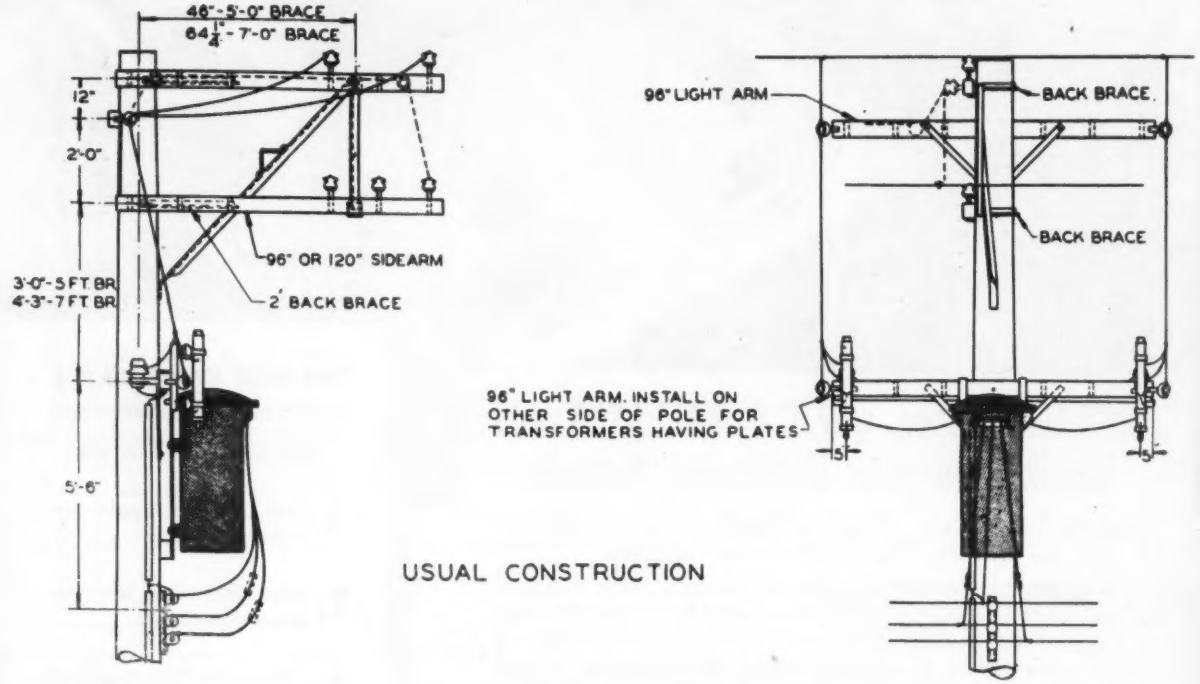
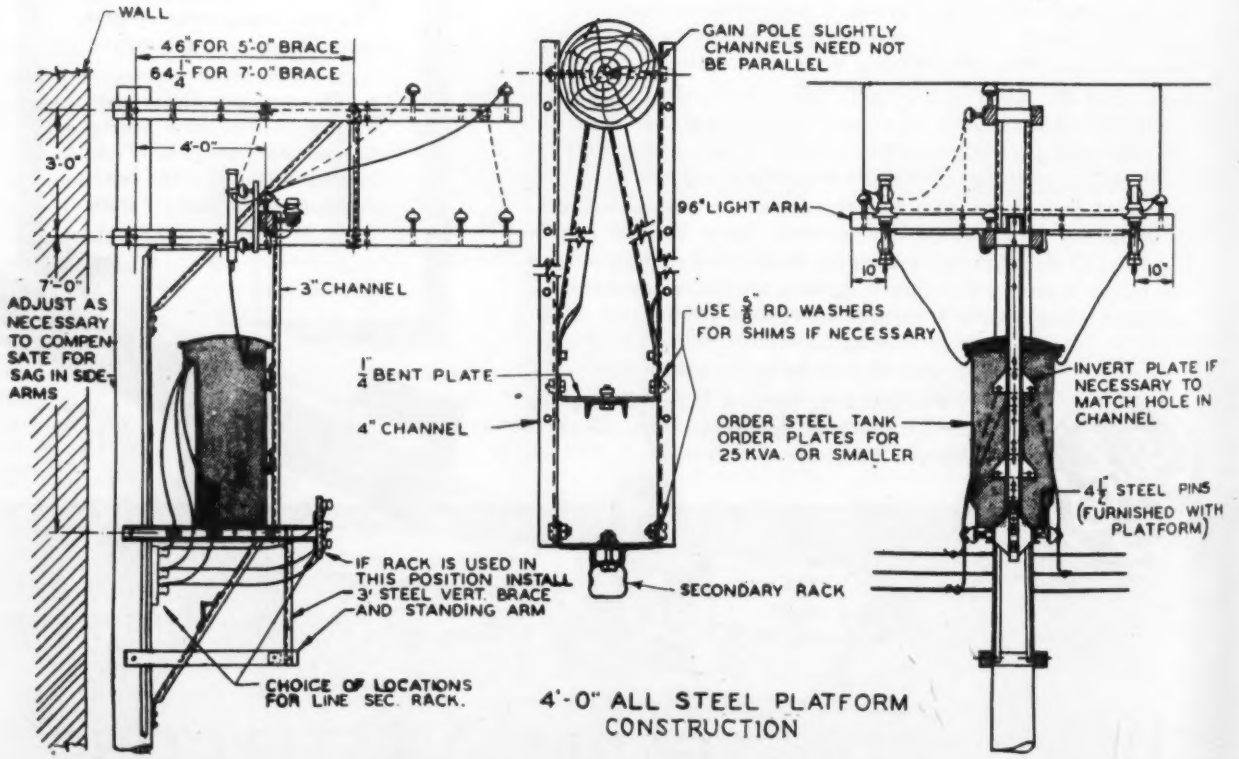
Buy all the BONDS you can —and keep all you buy

GENERAL ELECTRIC

HOW TO PROVIDE ROOM FOR TRANSFORMER TRAINERS

Accompanying illustrations show a 4-ft. all-steel platform arrangement that is used by Detroit Edison Co., in single-phase side-arm transformer installations to obtain clearance between buildings and primary transformer trainers. Also shown for comparitive purposes is the usual construction arrangement employed when ample clearance exists between buildings and transformer poles.




WALL
46" FOR 5'-0" BRACE
64¼" FOR 7'-0" BRACE
4'-0"
3'-0"
7'-0"
ADJUST AS NECESSARY TO COMPENSATE FOR SAG IN SIDE ARMS
3" CHANNEL
¼" BENT PLATE
4" CHANNEL
IF RACK IS USED IN THIS POSITION INSTALL 3' STEEL VERT. BRACE AND STANDING ARM
CHOICE OF LOCATIONS FOR LINE SEC. RACK.
GAIN POLE SLIGHTLY CHANNELS NEED NOT BE PARALLEL
96" LIGHT ARM
10"
10"
USE ⅝" RD. WASHERS FOR SHIMS IF NECESSARY
INVERT PLATE IF NECESSARY TO MATCH HOLE IN CHANNEL
ORDER STEEL TANK ORDER PLATES FOR 25 KVA. OR SMALLER
4½" STEEL PINS (FURNISHED WITH PLATFORM)
SECONDARY RACK
4'-0" ALL STEEL PLATFORM CONSTRUCTION

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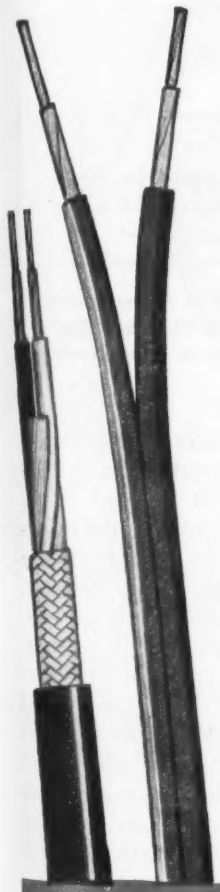
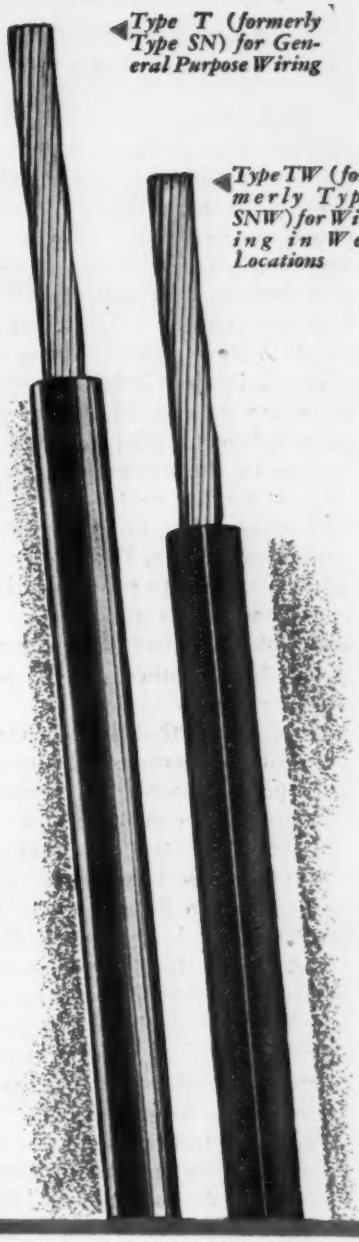




Type T (formerly Type SN) for General Purpose Wiring

Type TW (formerly Type SNW) for Wiring in Wet Locations

This high quality wire was developed before the war. It has proved its worth in thousands of different installations. Choose it for all wiring purposes: new wiring, rewiring and maintenance wiring. Two types are available in sizes 14 to 2,000,000 CM: Type T Flamenol Wire for general purpose wiring, Type TW Flamenol Wire for wiring in wet locations.

The small diameter of Flamenol Building Wire makes it easy to install and permits more copper to be placed in conduits. Its tough insulation has long life, is high in dielectric and mechanical strength, is flame retarding and is resistant to oils, acids and alkalies. In addition, Type TW Flamenol Wire insulation has low moisture absorption.

G-E PORTABLE CORDS

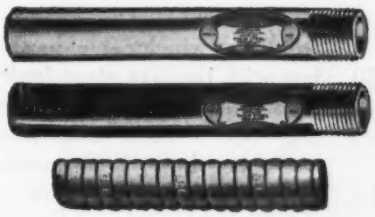
Both Flamenol Cords and Buna Cords are in the G-E cord line. Both are available in three types: heavy duty, medium duty and rip cords for use on lamps and small devices. These cords are mechanically strong, easy to handle, light in weight and flexible.

For Further Information on Flamenol Building Wires or Flamenol or Buna cords or G-E conduits or wiring devices, see the nearest G-E Merchandise Distributor or write to Section CDW1053-9, Appliance and Merchandise Department, General Electric Company, Bridgeport, Conn.

*Reg. U. S. Pat. Off.

G-E CONDUITS AND WIRING DEVICES

General Electric also offers five conduits and a full line of wiring devices, including: White and Black rigid conduits, EMT, flexible metal conduit, Fiberduct; and switches, lampholders, outlets, fuses, etc.



GENERAL ELECTRIC

Anticipator Controls Furnace Temperatures

By M. J. MANJOINE
Westinghouse Electric Corp.
East Pittsburgh, Pa.

Development of a vacuum-tube thermocouple device characterized by its anticipating nature, increases the sensitivity and response of conventional temperature controls by a thousand percent. It consists of two thermocouples of different thermal capacity and an electric heating element, in an evacuated glass envelope. Changes in electric furnace temperatures are anticipated and corrective steps taken to minimize the cyclic swings in temperature characteristic of most furnace controls.

A heat-treating furnace varied over a range of 50 deg. F: (plus or minus 25 deg.,) prior to supplementing the control with this anticipator. After connecting and adjusting the anticipator the variation was 5 deg. F. (plus or minus 2½ deg).

Because of the different characteristics of the thermocouples used, the anticipator reacts to temperature changes quicker than the furnace and initiates the control operation sooner and minimizes temperature fluctuation. The two thermocouples in the instrument and the control thermocouple in the furnace are connected in series so that the polarity of the couple with less thermal capacity is additive and the couple with greater thermal capacity is subtractive with respect to the furnace couple.

When the two couples in the anticipator are at the same temperature, the voltage from the control thermocouple to the control mechanism is constant. At the time that the control thermocouple institutes a change in control current, for example, starts the heating part of the cycle after having been off, the change is felt first in the two thermocouples in the anticipator. However, the thermocouple with the lower thermal capacity heats faster than the other and the thermocouple voltage at the temperature control mechanism is increased. This increased voltage causes the controller to change to cooling, thus preventing the furnace temperature from overshooting the desired maximum. When the opposite action takes place and the furnace is in the cooling portion of the cycle, the anticipator thermocouple with larger thermal capacity cools more slowly and its reversed polarity causes the control mechanism to change to heating and keep the furnace temperature from overshooting the minimum limit. A variable resistance in the heater circuit of the anticipator provides a means of controlling the frequency of operation of this supervisory furnace-temperature control.

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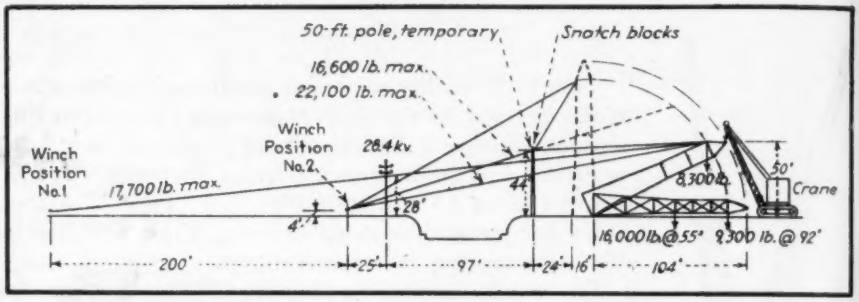
Erects Steel Tower in Close Quarters

H. L. DODD
Asst. Supt., Electrical Construction
Wisconsin Electric Power Co., Milwaukee, Wis.



TOWER ERECTION PROBLEM created by location of essential 26.4-kv. feeder adjacent to new transmission tower was solved by locating winch at position No. 2 and rigging winch cable over blocks on a temporary 50-ft. pole. Note interference between winch cable and power line with winch in position No. 1

Solution to a problem in rigging that arose in erecting one of the steel towers for the new 132-kv. line of Wisconsin Electric Power Co. between Granville and 96th Street substations is illustrated in the accompanying diagrammatic sketch.

One of the line's 86 towers is located within 121 ft. of a 26.4-kv. war-plant feeder paralleling a highway that the new 132-kv. circuit crosses. Because of the essential nature of the work at the war plant even a short interruption on the 26.4-kv. feeder could not be tolerated. The completely assembled tower, therefore, had to be raised from the ground without in any way jeopardizing service on this adjacent feeder.

With the winch located in position No. 1, 350 ft. from the tower foundation, as had been done at other locations, it was found that the winch cable would foul the 26.4-kv. line and its underbuilt distribution circuit in the initial phases of the lift. Ordinarily towers were raised the first 50 ft. by a travelling crane. From this position the winch pulled the towers up to vertical.

It was at the point where the winch took over the load that interference with the 26.4-kv. war plant feeder would occur, with the winch in position No. 1.

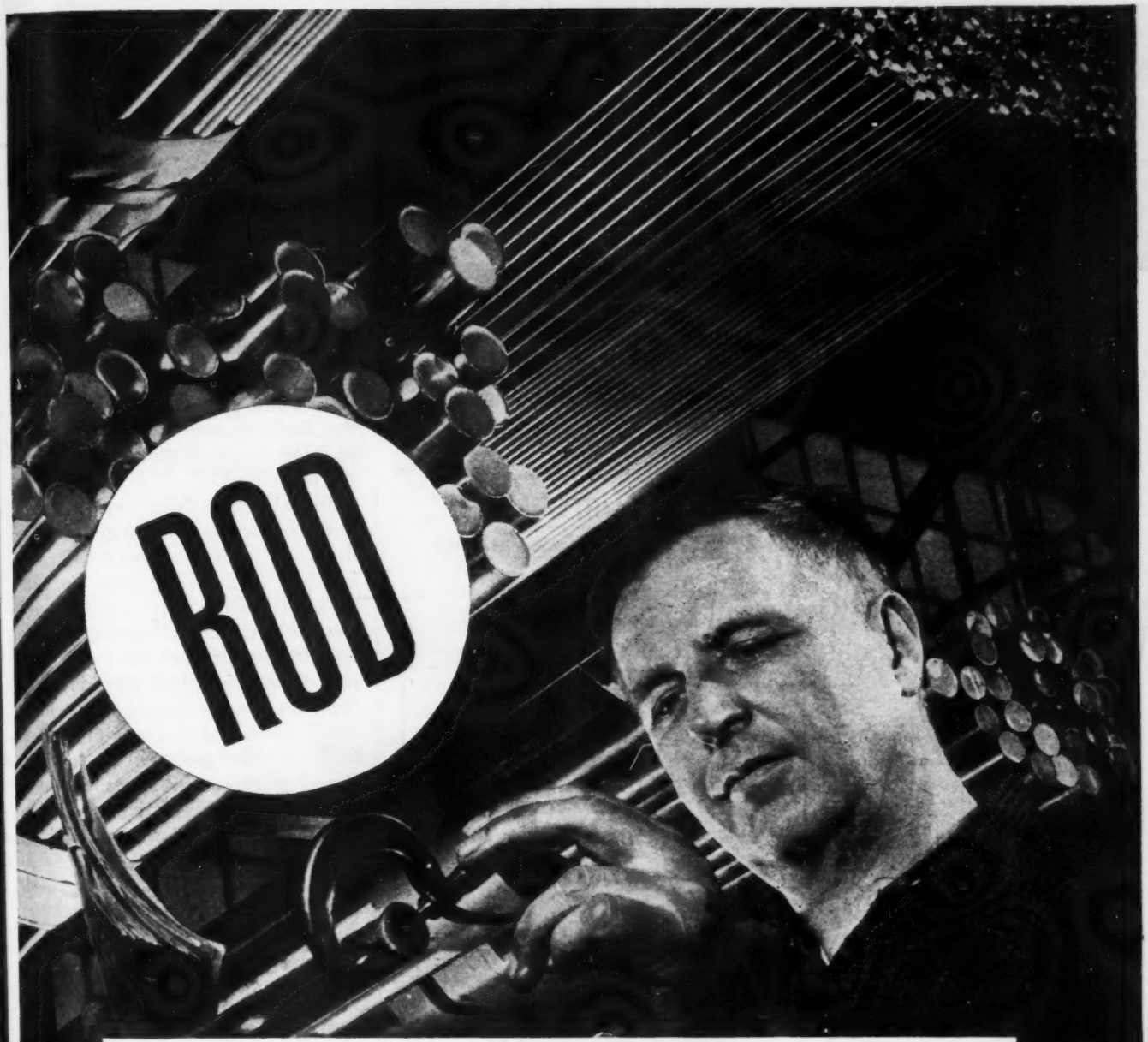
By moving the winch up to position No. 2 and running the cable direct to the tower it was found that interference would be avoided in all stages of the lift. However, the resulting total tension of 22,100 lb. in the double winch cable, ⅝-in. diameter, exceeded the 20,000 lb. value considered safe for tower footings, rigging and anchors.

However, by setting a temporary 50 ft. pole 24 ft. out from the tower footing and passing the winch line through snatch blocks on this pole 44 ft. above ground total tension would be reduced to 16,600 lb., well within safe limits.

When the tower was raised to the point where the winch cable ran in a straight line to the tower the cables were removed from the blocks and the remainder of the lift completed by direct pull. If desired, however, the cable could have been left in the blocks without complications.

Note that with the winch in position No. 2 the winch cable does not interfere with the war plant feeder at any point in the lift. However, had position No. 1 been used interference could not have been avoided short of rigging the winch cable above the existing line, at considerable hazard to both service and safety.

Tower erection on the Granville-96th Street line was done by John Hennes Co., Milwaukee construction



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Commercial Bronze	Special Alloys
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Available in coils or straight lengths, depending on size and composition. For full details, prices and deliveries, consult your Revere Distributor or us. The Revere Technical Advisory Service will gladly work with you in selecting the rod best fitted for your needs. For this assistance, which is given without obligation, just write the nearest Revere Office.

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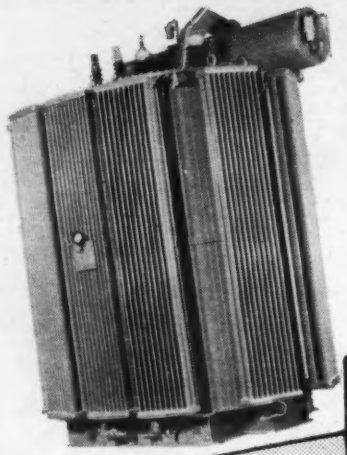
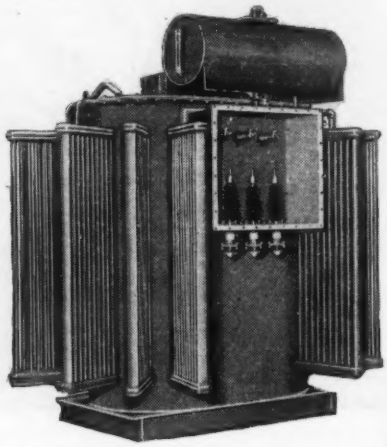
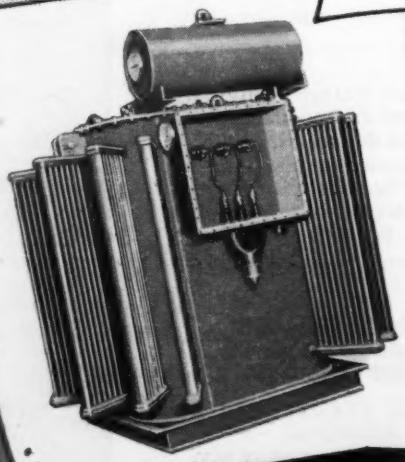




above) Uptegraff Power Transformer; 4000 KVA. A type designed for giving heavy-duty continuous service.
at right) This Uptegraff Power Transformer, 1000 KVA, has long been giving uninterrupted service with a public utility.
below) Uptegraff Power Transformer, 3-phase, 1000 KVA, with magnetic oil gauges on expansion tank and high-voltage junction box.



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Write for Power Transformer Bulletin No. 111.

R. E. UPTEGRAFF *Manufacturing* CO.
SCOTTDALE, PENNA., U.S.A.

contractors. Stringing of conductor on the line was done by Wisconsin Electric Power Co. crews under the direction of W. A. Erdman, general foreman.

•

Peaks Reduced by Storage-Battery Welders

Storage battery welders apparently reduce peak welder loads as much as 90 percent for typical welding operations, making unnecessary the reserving of capacity in generation and distribution plants to accommodate the high momentary demands imposed by conventional resistance welding equipment.

Breaking the large welding currents is reported facilitated by the development of a contactor-controller by the Progressive Welder Co., Detroit, Michigan, capable of the arcless interruption of currents up to 30,000 amp. or more. A carbon-pile rheostat provides high electrical conductivity when subjected to mechanical pressure with decrease of conductivity as the pressure is released. Proper selection of the area and thickness of carbon discs, rate of application and release of pressure and the time of contact permits complete control of battery current for any welding operation within the capacity of the batteries provided.

Practical elimination of reactance losses permits more consistent welds since the effective welding current is not altered materially by the amount of metal fed into the throat of the welder.

All types of materials capable of being resistance-welded can be welded with battery-powered welders. The selection of the machine to do the job is primarily the selection of the number of cells required to furnish the maximum welding current required for the type and thickness of the material to be welded and the duty cycle involved. A standard dry disk type rectifier keeps the cells charged and its capacity need only be that required to supply the energy used by operating automatically at a continuous low demand.

On an ordnance job, 240 spot welds had to be made per unit on $\frac{1}{8}$-in. steel stampings. Using a conventional a.c. type of machine, a transformer of a minimum of 150 kva. demand was required. Duty cycle was approximately 20 percent. Even with this,

LEAST RESISTANCE

. . . ROEBLING BARE COPPER STRAND

. . . ROEBLING WEATHERPROOF CABLE

WHEN PLANNING your new lines, or replacements, consider *all* the factors that reflect truly economical distribution. And among them, don't overlook the long-term, low-cost service Roebling products offer.

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For the overhead job in populated areas . . . for circuits from transformers to homes and plants . . . turn to Roebling weatherproof wires and cables. They've all the operating economy of the bare strand, in addition to high grade, weather-resisting coverings and compounds conforming to requirements of the N.E.M.A.—URC Type. Triple braid cables carry National Electric Code tags.

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The American Bird-White combination equipment offers; — low initial heights, in some instances almost flush fittings — extreme elevations, up to 28 feet — sturdy construction, without excess bulk — rigid stability — elimination of sidesway at all tower elevations — assured with specially designed hydraulic jacks. Trouble-free high pressure rotary pump actuated by a power take-off permits smooth operation in the raising and lowering of the tower controlled from the lift platform.

For complete details and specifications write today —

THE American COACH & BODY CO.

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there was a tendency for the transformer to heat up, indicating the high loads involved during welding.

A battery welder was installed on the same job. The welder had 12 battery cells. Operating on the same duty cycle, continuously for 20 hours a day (29,000 spot welds per day) it was found possible to keep the battery charged with a maximum line load for the charger of less than 30 kva. The charger operated on 3-phase with a load per phase of 80 amp. Power factor was around 80 percent, compared with approximately 50 percent for the a.c. welding installation.

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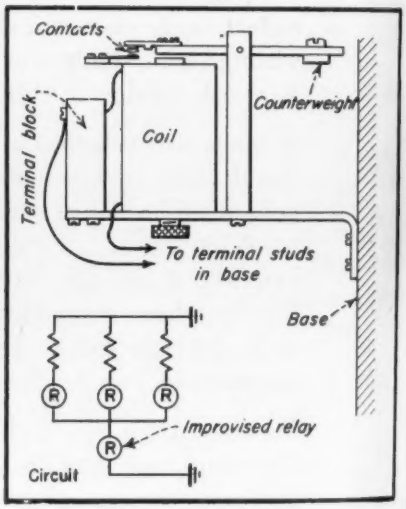
Improvised Relay for Low Volt-Ampere Use

A. R. CONSTANT, Jr.
and M. H. SYKES
New England Power System
Tewksbury, Mass.

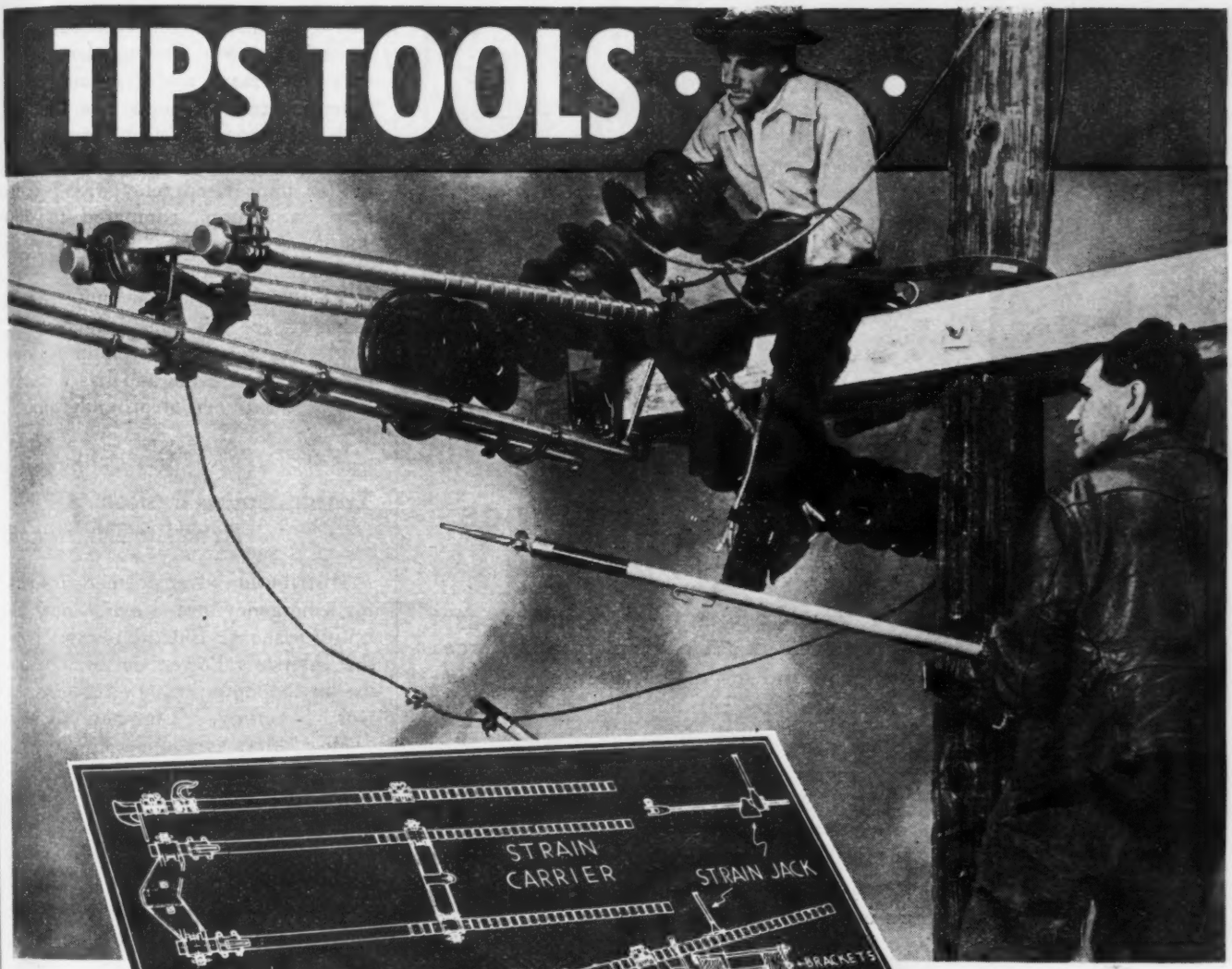


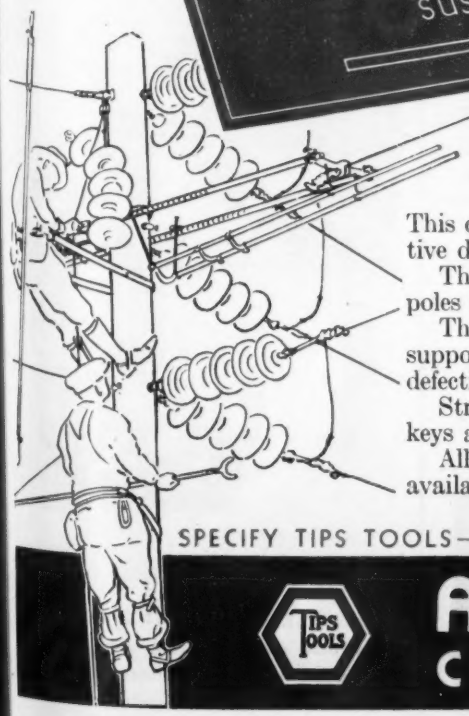
ELEVATION and schematic diagram of high-speed ground relay devised for low volt-ampere burden

The application of instantaneous ground relays to low-ratio bushing-type current transformers generally results in inability to reach a low primary current setting due to the extremely high volt-ampere burden of the ground relay. We recently had a Westinghouse "SC" type relay set at 1 amp. installed in the neutral of three 25-turn current transformers and found it required about 80 primary amp. to circulate 1 amp. through the ground relay. At this location is was desirable to have a maximum setting of 25 amp.

The situation was readily met by using one current element of an old Westinghouse "HF" relay of the balanced beam type. Any low burden

TIPS TOOLS · · ·





· · simplify dead end insulator changes on live lines

This diagram illustrates the simplicity of the Tips Tools used for changing defective dead end insulators without interrupting service.

This method is used on cross arm construction (above), dead end corners on poles (left), and tower dead ends.

The new "suspension cradle" which hangs below the two-pole "strain carrier" supports the insulator string as the lineman slides it into position for changing defective units.

Strain is released by a ratchet jack attached to the "strain carrier." Cotter keys are removed by a new spring-action cotter key tool.

All Tips Tools are tested to withstand 75,000 volts per foot of pole. They are available for all types of live line maintenance.

SPECIFY TIPS TOOLS—"THERE'S NOTHING TOO GOOD WHERE LIFE IS AT STAKE."

TIPS TOOLS

A·B·CHANCE CO·
CENTRALIA, MISSOURI.

ABC INDUSTRIES

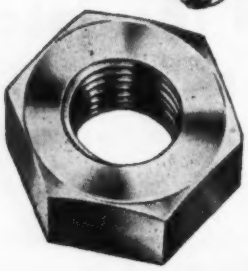
EVERLASTING

against the ravages of time

For countless ages, the Pyramids of Egypt have withstood the disintegrating forces of time and the elements. In comparison with the span of human life, the Pyramids are everlasting. In applications without number, Harper bolts, nuts and other fastenings resist rust, corrosion and other destructive conditions. Compared with assemblies they hold together . . . or with common steel bolts . . . Harper Fastenings are everlasting.

everlasting fastenings

Every Harper fastening is made of brass, bronze, copper, Monel metal, or stainless steel (none of common steel). Harper stocks include over 4360 items of bolts, nuts, screws, washers, rivets, nails, and special fastenings. New stock items are being continually added. Special fastenings made to order quickly from large stocks of metal in bars, rod, wire, sheet and other basic forms. Write for 104 page, 4 color catalog.



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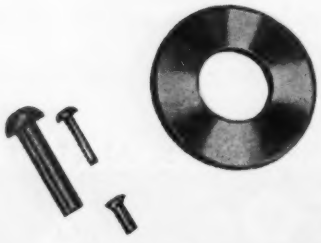

BRASS . BRONZE
COPPER . MONEL
STAINLESS

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Chicago

relay of the plunger type must of necessity have a moving element of very low mass and friction. The potential restraint coil was cut off and the current element mounted in an old "CO" relay case. The burden of this improvised relay was 7 volt-amp. at 5 amp., compared to 200 volt-amp. for the "SC" relay it replaced.

No trouble was encountered in reaching the 25-amp. primary setting. The relay has been in service for over six months and has already cleared a number of ground faults.

•

Transformer Trailer Artfully Disguised

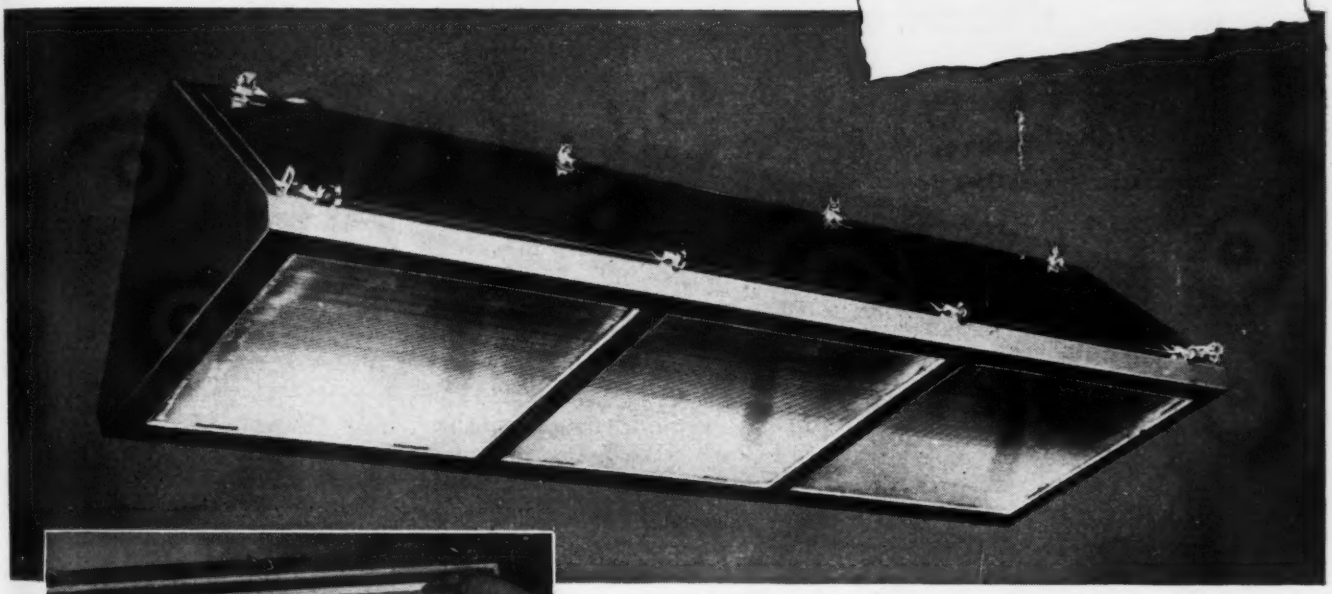
Distribution transformer trailers for emergency use are not new on utility systems. But the one built by the Interstate Power Co. system for use in Dubuque has several features worth reciting. Chimney of the "house" that surrounds the 50-kva. 2,300-115/230 volt transformer serves two purposes; it is both the outlet for the flexible 5,000-volt, rubber-covered primary and secondary leads but also performs a ventilating function. Bottom of the house is open and air passes up around the transformer and out through the chimney. The trailer is provided with leveling jacks at either end and they are welded to the trailer frame. Trailer can be transported and connections made by one man.

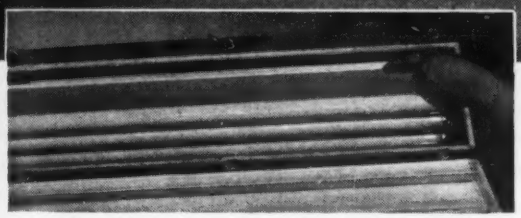
EMERGENCY TRANSFORMER—mounted on trailer and used to lessen duration of service interruption, disguised as "house" providing ventilation

★*Dust-Tight* CONTROLESCENT UNIT that stays *Dust-Tight*

for ✓CONTROLLED INDUSTRIAL LIGHTING
✓DUST AND DIRT EXCLUSION
✓EASY SERVICING & MAINTENANCE

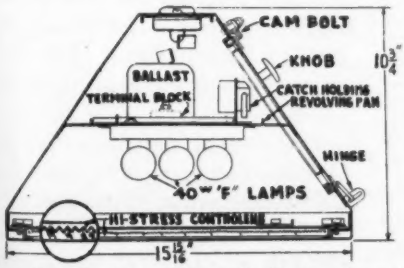
Holoflux
HOLOPHANE | FLUORESCENT



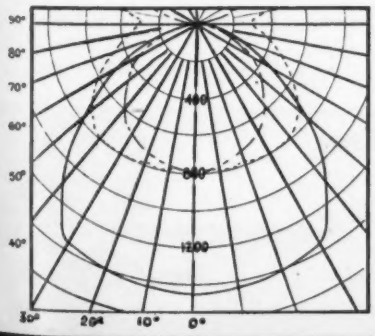


SIDE DOOR opens for servicing. Entire plate holding sockets, starters, lamps and ballast can be rotated for cleaning or inspection; plate can be removed and replaced through door.

Holoflux Unit No. 9061 . . . Accommodates three 40 Watt Fluorescent Lamps . . . (No. 9062 for two lamps)



Above: Cross-Section...Below: Distribution Curve 9061



- **THREE HOLOPHANE HI-STRESS CONTROLENSES** (Smooth outside) permanently sealed in bottom of unit.
- **DUST-TIGHT CONSTRUCTION** resists dust and dirt, reduces depreciation to a minimum.
- **UNIT GIVES INTENSIVE LIGHT DISTRIBUTION**; most efficient because of low interception loss.
- **GLARE** is effectively prevented by Controlens redirection of high angle (wasteful) light to useful areas.
- **HI-STRESS CONTROLENSES** withstand mechanical and thermal shock.

★ **APPROVED BY UNDERWRITER'S LABORATORIES** for Class II Groups E, F, G

Consult Holophane Engineering Service . . .
Write for Data Sheets . . . No obligation.

ARMY E NAVY
Holophane

HOLOPHANE COMPANY, INC. . . . *Lighting Authorities Since 1898*
342 MADISON AVENUE, NEW YORK 17 • Holophane Co., Ltd., 385 Yonge St., Toronto, Can.

LOAD BUILDING

Commercial · Industrial · Residential · Rural

Utility Contest Rewards 4-H Club Achievement

F. I. FAIRMAN
Director Customers Service
Kentucky Utilities Co., Inc., Lexington, Ky.

Many prize contests have been conducted from time to time in the past to reward achievement among individual 4-H club members but few have been rewarded achievement of 4-H clubs as a whole until recently when Kentucky Utilities Co., Inc., Lexington, sponsored a competition intended to encourage more and better 4-H club work in the 72 counties of its territory.

The competition, for $895 in prizes, will be supervised by the extension division of the College of Agriculture, University of Kentucky. Awards will be made to the clubs making the highest point scores based on achievements of individual clubs in the field of organization, project work, Achievement Day and Rally Day attendance, fair and show exhibits and prizes, newspaper articles published on club activities, social and recreational work and club financial achievements.

Participating in the contest are 1,107 community 4-H clubs with a membership of 48,251 rural boys and girls in the 72 Kentucky counties serviced by the company. Under the contest rules each club will turn in a report on or before October 1, 1945, covering club achievements between January 1, 1945, and September 30, 1945, using a prepared score sheet showing points made in each project or activity.

A cash prize of $50 will be awarded to the champion 4-H club in each of the five districts into which the 72 counties are divided. Also $10 will be awarded to the club in each of the counties having the highest point score.

Interest in this competition has been stimulated through participation by E. R. Murphy, farm service adviser, Kentucky Utilities, in 4-H club summer camps where, in addition to teaching the various uses of electricity on the farm, he showed educational films to the club audiences.

•

Miniature Kitchens Draw Future Prospects

With an eye steadfastly on the new and remodeled home market for major appliances, Nebraska Power Co., Omaha, is using all the sales tools at its command to foster the all-electric home idea. Most effective of these tools, and one which Harry R. Fiene, builders representative, says is attracting more attention than any display the company has ever used, is a display of seven miniature kitchens and a miniature laundry currently drawing crowds in the company's Electric Shop.

The models, shown, were built by M. L. Rouse, display director of Nebraska Power Co., and are based on the Hotpoint booklet "Your Next Kitchen." They are complete to the last detail as the accompanying close-up pictures testify. On the floor of each miniature kitchen the Hotpoint booklet lies open to the room on display so visitors may see not only the picture but the kitchen as it will look in the home.

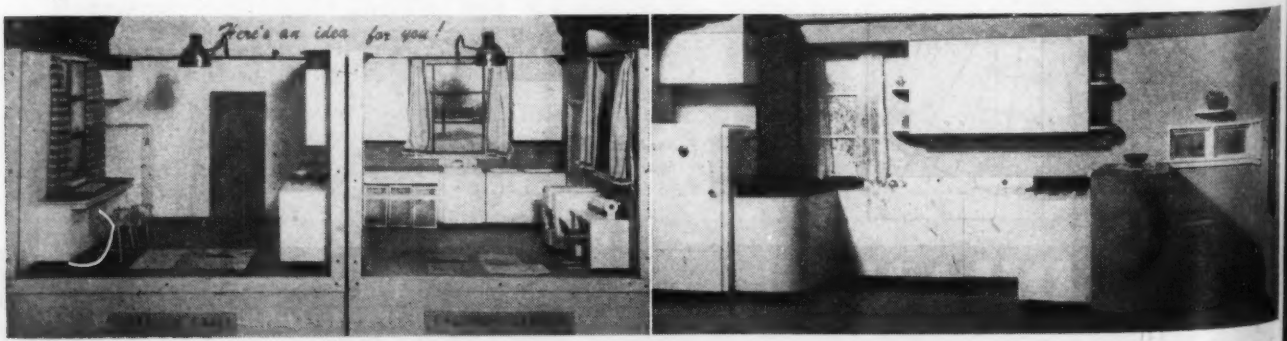
Evidence of the effectiveness of these mighty miniatures as sale builders is seen in the fact that a number of electric home prospects have already been traced to the display.

•

Dealer Reactions to Utility Sales Policy

To secure dealer attitude on its no-merchandising policy and to aid in formulating post-war sales plans, the Utah Power & Light Co., during the spring of this year, sent out an attractively gotten up booklet in which it stated its plans,* and asked dealers to express their approval or disapproval. The company first stated its policy in these words: "All of our efforts and plans will be directed toward the securing of new customers and the development of increased use of electric service by present customers. We will promote *use* and sell advantages, assuming that the company will not sell merchandise. The only exception to this might occur should the necessity arise, during the post-war period, of us assuming the responsibility of securing acceptance of some particular item or type of service. We shall, of course, continue to promote the sale of electrical merchandise in all our advertising and sales activities, and shall continue to ask people to

* ELECTRICAL WORLD, July 7, 1945, page 144.



EYE CATCHING MODELS of all-electric kitchen and laundry draw prospects to Omaha utility. At left are two of eight models displayed. At right a close-up of one of the kitchens reveals the painstaking attention to detail in the models

The General Electric Lamp Department
invites you to attend the

Victory Lighting Jubilee

Premiere of 1946 Lighting

First Showing of Today's Lighting Fixtures and Portable Lamps for Homes, Stores and Factories. Exhibits by more than 150 Leading Manufacturers, under Sponsorship of the Lamp Department of General Electric Company.

NOVEMBER 26 THROUGH NOVEMBER 30

17th Regiment Armory, 34th St. and Park Ave., New York City

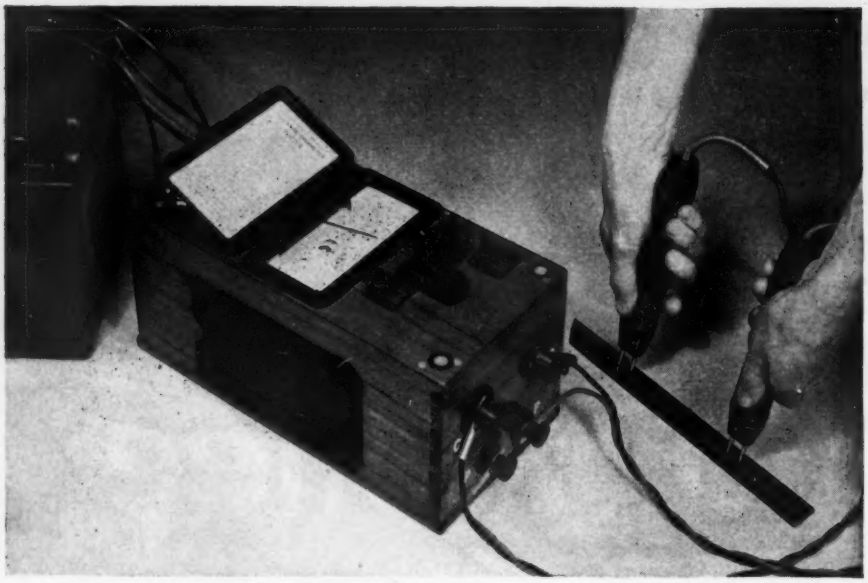
Here is your first opportunity to see a representative showing of the lighting fixtures and portable lamps that are being shown for 1946. Under the sponsorship of the G-E Lamp Department, outstanding manufacturers of lighting equipment will disclose the results of their work to date. Many manufacturers, for example, will show equipment for the new G-E SLIM-LINE and CIRCLINE Fluorescent Lamps, and for heat, drying, germicidal and sun lamps. For the first time you will be able to see all under one roof, how the lighting industry is developing new lamps, new materials and new designs for all markets — home, commercial and industrial. Another feature will be demonstrations of recent developments of General Electric Lamp Research.

The Victory Lighting Jubilee will be the most comprehensive exposition in the history of the lighting industry. It will bring the latest trends in lighting to department, furniture and chain store buyers, electrical wholesalers, electrical contractors, lighting companies, store owners, architects, builders, engineers, factory owners and executives, and similar groups. Plan now to attend!

G·E LAMPS

GENERAL ELECTRIC

Splits an Ohm into a Million Parts



"DUCTER"

LOW RESISTANCE OHMMETER

measures current-carrying ability of circuit breakers and switches down to .000001 ohm

Built to "stand the gaff" of field use . . . reads directly by pointer deflection . . . so accurate and reliable that your laboratory can readily give O. K. . . . such is the Ducter Ohmmeter, a rugged "Megger" type instrument that is now finding important uses in circuit breaker maintenance and for testing other low resistances that today must carry their rated loads.

The Ducter operates from a storage battery, and by applying test leads, one can actually see at a glance the condition of a vital part of a circuit breaker, switch or joint—namely, its contact resistance. The Ducter Ohmmeter does for measuring conductor resistance what "Megger" Instruments do for testing insulation resistance.

Write for illustrated descriptive Bulletin 1635-W

JAMES G. BIDDLE CO. • **1211-13 ARCH STREET PHILADELPHIA 7, PA.**

buy this merchandise at their *dealers' stores.*"

The direct question was then asked, "Are you in favor of this policy of promoting the sale of electrical appliances and equipment through dealers only?" 98.4 percent said yes, 1.6 percent said no. The next question was, "Do you think certain items should be sold through the power company?" 18.4 said yes, and 81.6 percent, no. The company stated that it planned practically to double its sales force and asked if dealers would take full advantage of this increased sales assistance. 98.9 percent said they would, and 88.6 percent expressed a desire to have the utility help in training dealers' sales forces.

Distribution of Prospects

The question as to how to distribute prospects names fairly divided dealers into four sharply defined groups. 41.5 percent favored giving leads to only one dealer at a time, rotating them among all dealers in the community. 58.5 percent opposed this plan. 68.8 percent believe that leads should be given to all dealers in the community at the same time. 31.2 percent opposed the idea. This question of how to distribute names of prospects was by far the most discussed and commented-on subject. Comment ran a wide gamut of opinion and at the time of this writing the power company had not made up its mind just how it would handle the prospect question.

Another question that brought forth interesting facts and opinion concerned appliance service departments and sales training classes. 41.2 percent of dealers have service departments, 58.8 percent do not. 85.8 percent think a service department would help build sales, 14.5 percent do not. 65 percent think a service department would pay its own way, 35 percent do not. 90.1 percent favor organization of training classes, 9.9 percent do not.

On the matter of display space for dealers during special campaigns, 89 percent would like to display their appliances in the utility's stores and windows; 11 percent said no. 83.4 percent think displays of appliances with no dealers' name shown, would be sales-stimulating, 16.6 percent do not. Asked if they thought home service activity was worth-while, 97.7 percent think it is helpful in stimulating sales.

Dealers particularly stressed dem-

Seyler buying helps?

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SURFACE CREEPAGE

GETS THE RUN-AROUND *from* SURETY TURN-CUFFS

Built on the principle of a petticoat insulator, Surety Turn-Cuffs minimize surface creepage, keep the jolts away in all kinds of weather. Always they're comfortable, give you "finger freedom" and tops in safety.

Linemen rely on Surety Turn-Cuffs. Painstaking production makes these gloves wear longer, resist snags and abrasion. Each pair gets a complete submersion test to make sure they exceed safety standards. Your own field tests will prove the superiority of Turn-Cuffs. Write today.

THE Surety RUBBER COMPANY
CARROLLTON, O

onstrations of farm equipment in commenting about the huge farm market. Few comments and suggestions were made by dealers regarding promotional activities in the commercial field. 94.7 percent will take advantage of the utility's free lighting specialists' service; 5.3 percent are not interested.

The company's presentation of an extensive and well-coordinated advertising campaign brought forth unanimous approval as an aid in selling electrical appliances and as a good opportunity for dealers to tie-in their own advertising. 95 percent would like to receive window display material. Opinion was asked of the plan to use low-cost electricity as a sales appeal and 95.9 percent answered that they would use this appeal.

Those responding were asked to designate the type of store each operated. Replies by percentages were: electrical appliance stores, 18; hardware stores, 15.9; furniture stores, 12; department stores, 10.9; combination stores, 9.8; drug stores, 8.8; contractor dealers, 8.2; lumber yards, .5; novelty stores, 2.7; others, 13.2; total 100 percent.

In presenting results of the survey the company has issued a two-color booklet with double-page spreads. The left-hand page repeats a page of the original booklet, and on the right-hand page results and comments are given.

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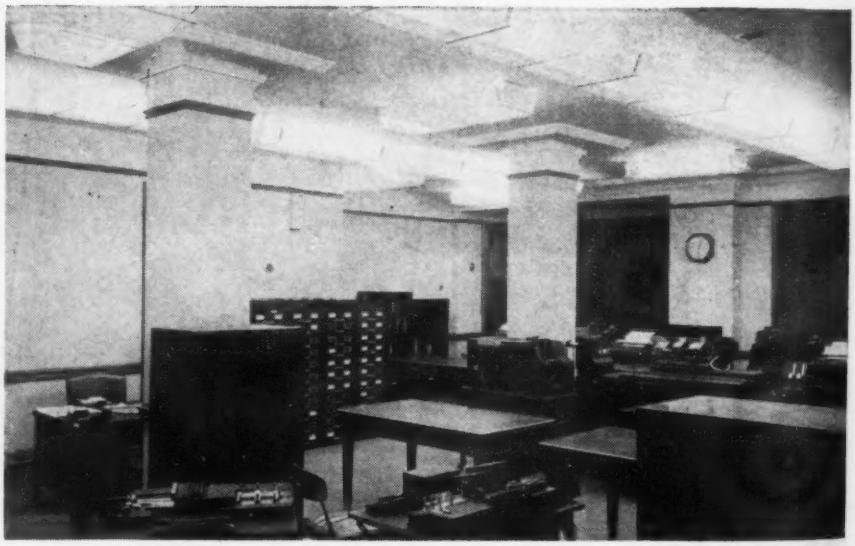
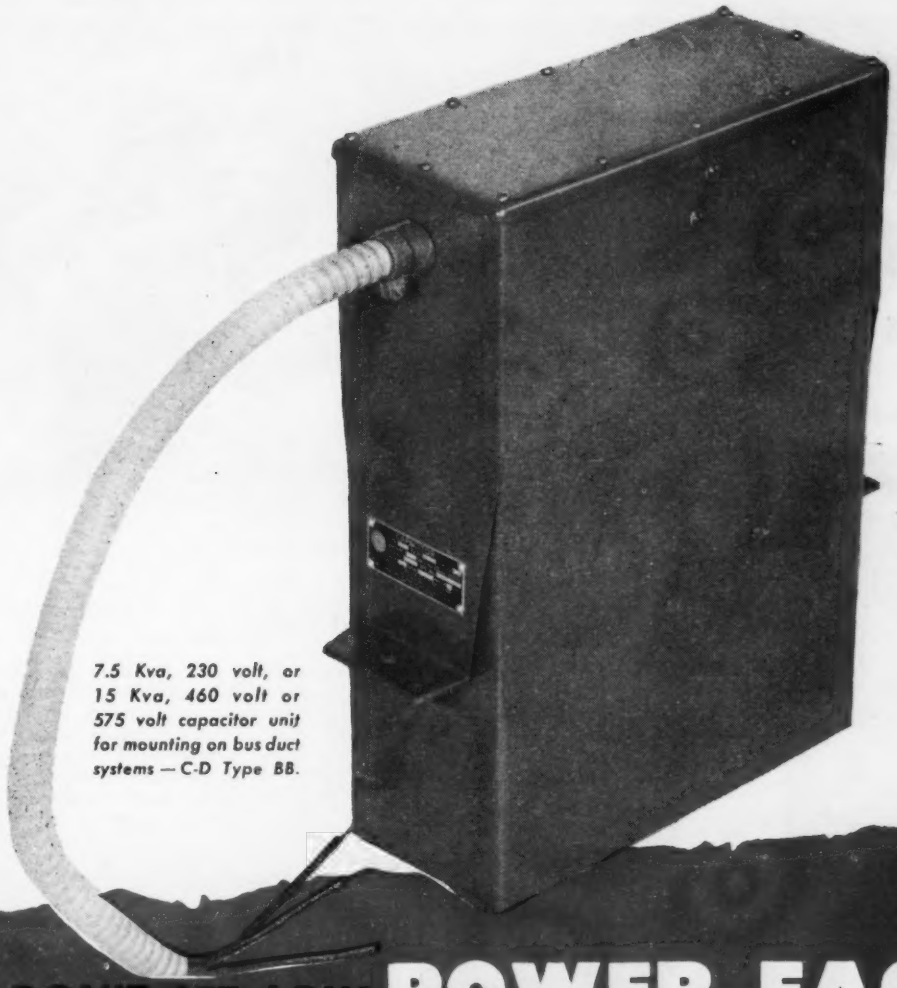
Utility in Role of Lighting Customer



THIS UTILITY TABULATING department office quintupled the intensity of illumination by adding only 500 watts to the connected load, or less than that of a flat iron

When the Connecticut Light & Power Co.'s executive offices at Hartford were occupied some years ago, a total lighting load of 4,500 watts in tungsten units was installed, and a number of automatic machines used in tabulating were served by the equipment. The office lighting was designed to deliver 10 to 15 foot-candles on the working areas; but as time passed operators found themselves subject to more or less eye-strain. The work involved the preparation and examination of large numbers of card records for the machines, and when the lighting intensity was checked it was found to be but 10 foot-candles.

As soon as the material was available the company replaced the old units with 25 ceiling type fluorescent units mounted in both continuous strip and single fixtures at a ceiling height of 10.5 ft. The ceiling was painted white and the walls light ivory. Subsequent measurements showed an average intensity on the working areas of 50 foot-candles, and the improvement in operating conditions was most marked. This betterment involved only 5,000 watts total connected load, or but 500 watts more than the previous installation, and as the company purchases electric service in this location from another utility in whose territory its executive offices are located, it is able to point to this example of "self-servicing" of its own load layout as an example of adhering to its own lighting prescriptions when visitors have occasion to note the modernized lighting.



7.5 Kva, 230 volt, or 15 Kva, 460 volt or 575 volt capacitor unit for mounting on bus duct systems — C-D Type BB.

DON'T LET LOW POWER-FACTOR BOOST YOUR OPERATING COSTS! . . .

install

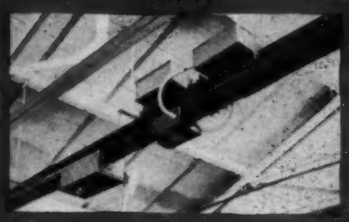
C-D CAPACITORS

GET MORE EFFICIENCY FROM YOUR EQUIPMENT

Get the drop on electrical outages caused by poor power-factor, low voltage and overloaded equipment. Install C-D Capacitors where they are needed. They are flexible — can be shifted readily anywhere in your plant. They will raise power-factor and keep motors running cool, up to their rated speed. Feeders will carry their full rated load without overheating or blowing fuses.

C-D Capacitors will increase the efficiency of your lighting equipment, too, if low power-factor is cutting luminosity.

Have our field engineer check your electrical installations to tell you where C-D Capacitors can help you. Write Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.



C-D Type BB Capacitor, 7.5 Kva, 230 volt, 3-phase, 60 cycles, mounted on a bus duct.

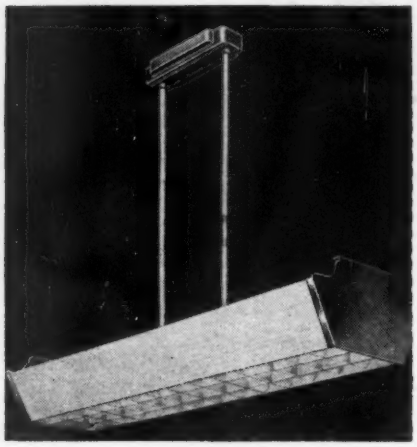
Cornell-Dubilier Capacitors

FOR POWER-FACTOR IMPROVEMENT

CARRIER CURRENT COUPLING • SURGE PROTECTION

NEW EQUIPMENT

Fluorescent Luminaire



No. A-4440, "The Wilson," permaflector fluorescent luminaire: utilizes four 40-watt T-12 lamps; length 48⅛ in., height 7¾ in., and width 15⅛ in. **Pittsburgh Reflector Co.**, Oliver Building, Pittsburgh 22, Pa.

Features reported for the luminaire are an egg crate louver bottom which is said to eliminate dust in the fixture, to shield the tubes, and to provide glareless illumination, and two Skytex glass side panels. Reflectors are reported as heat-resisting, baked-on white enamel finish; end and outside surfaces, as sprayed and baked-on metallic silver finish. Luminaire may be surface or suspension mounted, individually or in continuous rows.

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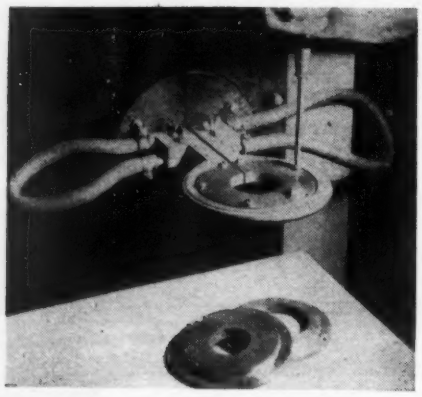
H. F. Equipment

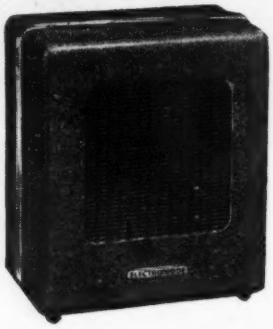


"Thermonic" master coils: complete set accommodates work diameters of from ⅛ in. to 3 in. **Induction Heating Corp.**, 389 Lafayette St., New York 3, N. Y.

Basic master coil consists of a water-cooled inductor block which is machined to take inserts. The complete master coil set consists of two master coils and 48 inserts housed in a wooden chest. The smaller master coil, with 27 inserts, accommodates round stock ranging from ¼ in. to 1¼ in. and these inserts are of three thicknesses for each diameter—⅛, ¼, and ½ in. The larger, with 23 inserts, takes stock ranging from 1½ to 3 in. and the inserts are in the same three thicknesses. Blank inserts which allow the user to cut any desired contour are also available.

•

Room Heater



Portable room heater: 1320 watts; 110 to 120 volt a.c. supply. **Electromode Corp.**, Mishawaka, Ind.

Resistor wire in the heating element is said to be completely enclosed in a tubular sheath which, in turn, is sealed in a one-piece finned aluminum casting. Heating element is said to operate at relatively low temperatures because of its high conductivity. Heater-fan combination or the fan only may be cut into the circuit by an "on-off" double-throw switch.

•

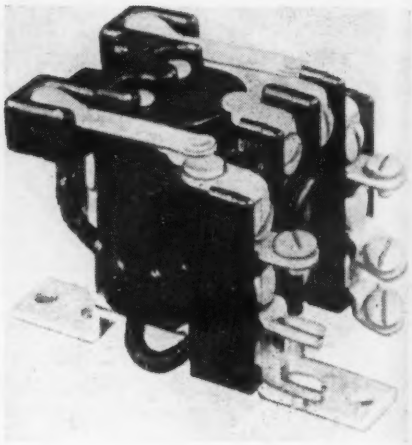
Cable

"PVX" type T conductors: sizes No. 14 to No. 4. **General Electric Co.**, 1285 Boston Ave., Bridgeport 2, Conn.

Cable assembly of the small-diameter non-metallic sheathed cable consists of the thermoplastic insulated conductors, a spiral-wrapped impregnated crushed-paper armor, waterproof jute fillers, a longitudinal paper wrap and a moisture-resisting, flame-retarding over-all braid. The cable is made in two- and three-conductor assemblies and the thermoplastic used is plasticized polyvinyl chloride.

BUYING ELECTRICAL EQUIPMENT?—McGraw-Hill's *Electrical Buyers Reference* is a convenient place to look first for manufacturers' product data, names and addresses.

Relay



Single- and two-pole a.c. and d.c. magnetic relays: ratings 10 amp. at 24 volts d.c. and 110 volts a.c. 5 amp. at 220 volts a.c. and one hp. on single phase 110 and 220 volts a.c. **R-B-M Mfg. Co.**, Logansport, Ind.

Relays are designed for industrial and electronic application. Single and double silver-to-silver contacts are employed in normally open, normally closed, and double throw arrangement. Armatures are reported to be self-aligning and wiring terminals are accessible from the front. The relays may be mounted either from front or rear.

•

Radio Equipment

"Ham-Mast," a 50-foot, plywood radio mast. **Plymold Corp.**, Lawrence, Mass.

Mast is made up of four sections which telescope and nest into one bundle 14 ft. 3 in. long. Each mast is supplied with two sets of guy wires, four anchors and a base plate. It is stated that two men can erect it in approximately 15 minutes and that it will withstand wind velocities of 100 miles per hour.

•

Insulation Tester

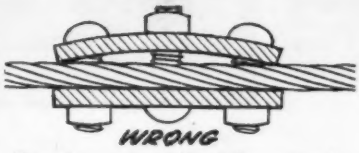
Model "799" insulation tester: range 0.1 to 10,000 megohms. **Weston Electrical Instrument Corp.**, 617 Frelinghuysen Ave., Newark 5, N. J.

Direct-reading insulation measuring device designed for applications where high testing potentials are not desired. The test potential is less than 50 volts d.c. All exposed metal parts are insulated for operator's protection and a "press-to-read" switch disconnects battery when not in use. Fer-

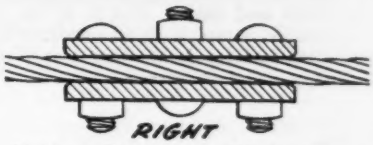
WHY?

DO HUBBARD STRAIGHT GROOVE GUY CLAMPS HOLD BEST?

1. **Because:** The **straight groove** eliminates the possibility of drawing a nut tight against an "arched" section which is out of contact with the strand.

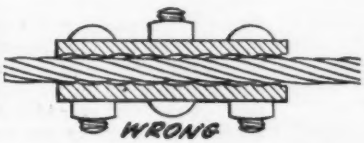


Clamping area reduced by warped section. Causes slippage at low strains.



Hubbard Clamps have full clamping area. Hold to breaking strength of most strands.

2. **Because:** The **straight groove** fits any and all twists, right or left hand and a variation in diameter without **creating** any high spots to **lessen clamping area.**

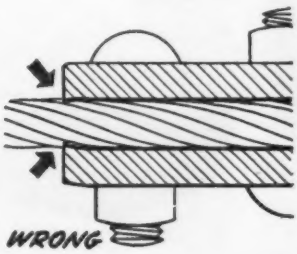


High spots in clamp reduce clamping area, cause slippage and injure strands.

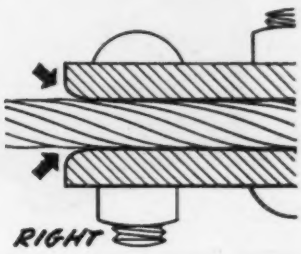
Hubbard Clamps fit snugly over any and all twists, right or left and variations of diameter.

3. **Because:** Bell-end grooves prevent injury to the strand.

4. **Because:** High carbon bolts prevent stripping or elongation. Heads are locked against turning while tightening—and the whole clamp is protected against corrosion by the best process commercially used — HUBBARD DOUBLE-DIP HOT GALVANIZING.



Sharp edge from sheared section injures and weakens the guy at end of clamp.



Rounded ends of Hubbard Clamp sections protect strand.

HUBBARD and COMPANY

Pittsburgh Oakland, Calif. Chicago

rules in panel permit attachment to lineman's belt or shoulder strap. Tester is reported as usable in checking leakage between windings in transformers, leakage of low-voltage paper and mica condensers, and for determining cable resistance. It is also usable in studying insulation characteristics and in making moisture absorption tests.

•

Lineman's Belt

Fabric lineman's belt: sizes waist measure 34 to 46 in. **W. H. Buckingham Mfg. Co.**, 513 State St., Binghamton, N. Y.

Belt is made of the company's new fabric material which is called Fabuck. This material is reported as tested at 6,300 p.s.i. The drop forged tested Dee rings are attached to a continuous strip of this material which extends clear around the belt. This is reported as an added safety feature and as eliminating the dependence upon rivets and chips. Belt is 4¼ in. wide and outside strap is 2 in. wide. Tool loop strap is formed into four loops, with ring, snap and tape carrier.

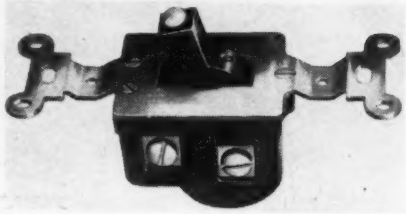
•

Beacon

Portable flashing beacon: 110 v. a.c. or d.c. supply. **Electronic Laboratories**, Indianapolis, Ind.

Unit contains a vibrator power supply and converts the 110 volt current to 2,000 volts d.c. to produce the flashing light beam. The light is said to produce 30,000,000 candlepower and to be visible for distances up to 20 miles. All connections are waterproofed as is the carrying case. Unit may be pole mounted if desired. Unit is designed for use at airports in smaller communities where stationary rotating beacon does not appear to be economical.

Delay Switch



"Tymzit" wall switch: rated 10 amp. at 125 volts or 5 amp. at 250 volts; delay or instantaneous action. **T. J. Mudon Co.**, 1240 Merchandise Mart, Chicago 54, Ill.

All-purpose light or power switch contains a toggle-lever arrangement which, although operated in the conventional manner, makes possible instantaneous "off" and a delayed-action "off." The time delay interval may be adjusted from zero to three minutes by adjusting the set screw on the toggle lever. Toggle lever also features a fluorescent tip which make the switch easy to find in the dark.

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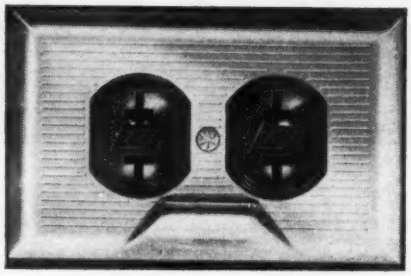
Illuminated Outlet



Illuminated duplex convenience outlet plate. **Associated Projects Co.**, 80 East Long St., Columbus 15, Ohio.

Outlet plate is molded in a single piece of ivory plastic and has a housing which contains a miniature light bulb. This lamp burns continuously and a soft flow is said to emit through the housing. The plates fit any standard duplex convenience outlet and are installed in the conventional manner except that, in addition, the two lead wires from the lamp are connected to the terminal of the outlet.

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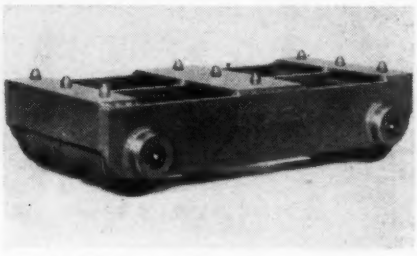
Dollies



"Skid-Rol" dollies: capacity 12 tons; 18½ in. high, 10½ in. wide, 4 in. high. **Techmann Industries, Inc.**, 828 N. Broadway, Milwaukee 2, Wis.

To load, the machine or heavy equipment to be moved is jacked-up about 6 in., the dollies are positioned, boards are placed on each of the dollies, and then the load is lowered. The cleats on the dolly imbed in the lumber prevent slipping. The load then can be rolled on all types of hard floors or pavements and rolled diagonally across railroad tracks. Each dolly is equipped with four all-steel rollers 3¾ in. in diameter.

•

Lamps

"Semi-silvered bowl" lamps: 300 and 500 watts. **General Electric Co.**, Nela Park Div., Cleveland, Ohio.

Two semi-silvered bowl lamps, which have a circular inside frosted "window" at the bulb's end, are designed to provide downlighting in commercial installations. The down light filters through a 2¾-in. diameter window in the 300-watt lamp and through a 3-in. diameter window in the 500-watt unit. The lamps have a mogul screw base.

TECHNICAL LITERATURE

Plastics—Culminating over two years of concentrated effort on the part of technicians in the plastics industry, the Society of the Plastics Industry, Inc., has just issued a classification of plastics molding materials. The classification provides data comparable to that which has been available to those employing wood, metals and other materials in their operations. It presents in chart form an authentic guide to the various properties of plastics molding materials as established by the material makers and molders. Both thermosetting and thermoplastic materials are included and values shown for their mechanical, electrical, optical, thermal, chemical and aging properties. Copies are available from The Society of the Plastics Industry, Inc., 295 Madison Avenue, New York 17, New York.

Maintenance — A bulletin entitled Modern Motor — Generator Maintenance and Repair Equipment contains hints on commutator care and an outline of troubles which may occur on various types of electrical machines having commutators and slip rings. It includes a remedy for each of the troubles. Copies may be secured from Ideal Commutator Dresser Co., Sycamore, Ill.

Symposium—"Symposium on Analytical Colorimetry and Photometry" presents a series of discussions by leading authorities in two divisions—Instrument Section and Chemical section. The authors cover some of the more recent improvements in apparatus for measuring light by aqueous solutions, development of superior methods of test based on such apparatus, and use of photometric methods in analytic chemistry. Copies of this 75-page publication can be obtained from American Society of Testing Materials, 260 S. Broad St., Philadelphia 2, Pa. for $1.00 each.

Porcelain Enamel—A booklet, which describes many of the characteristics and applications of porcelain enamel, is written for engineers, designers, manufacturing and sales executives. Advice as to proper design and procedure in obtaining best results is contained. Copies may be obtained from Porcelain Enamel Institute, Inc., 1010 Vermont Ave., N. W., Washington 5, D. C.

Plastics—"A. S. T. M. Standards on Plastics" is a 550-page book, dated May 1945, containing some 109 test methods, specifications, recommended practices, and definitions covering a wide range of plastics and related materials. Included in the standards are 24 which were developed by the committee on electrical insulating materials. Copies may be obtained from American Society for Testing Materials, 260 S. Broad St., Philadelphia 2, Pa. at $2.75 per copy.

NEWS ABOUT PEOPLE

J. D. Small Assumes Duties As Administrator of CPA

J. D. Small, recently named administrator of Civilian Production Administration, which will succeed the War Production Board, joined WPB in 1944 as executive officer, and was appointed

Harris & Ewing

J. D. Small

chief of staff by J. A. Krug, WPB chairman, last April. He headed the Committee on Period One which planned WPB's program for the transitional period between the end of the war in Europe and the defeat of Japan and which also drew up the WPB plan for reconversion of industry that went into effect on V-J Day.

Before joining WPB Mr. Small served as Navy materials control officer and landing craft coordinator, from 1943 to 1944. Before that he was deputy director of the Army-Navy Munitions Board from January 1942, to August 1943. A graduate of the U. S. Naval Academy, Mr. Small served as an officer in the Navy before entering industry. He was associated with the Dry Ice Corp. of America from 1926 to 1932 and with Publicker, Inc., from 1932 to 1941.

•

▶ Louis O'Sullivan has been appointed assistant general manager of the Quebec Hydro-Electric Commission. Successively field engineer, design engineer and transmission and right-of-way engineer since joining the old Montreal Light Heat & Power in 1923, Mr. O'Sullivan was made general executive assistant early in 1942.

•

Arnold Hogan New Head of Indiana Association

Arnold Hogan, vice-president of the Indiana & Michigan Electric Co., Marion, Ind., who was elected president of the Indiana Electric Association at the annual meeting held recently in French Lick, has been associated with the utility industry for the past 29 years.

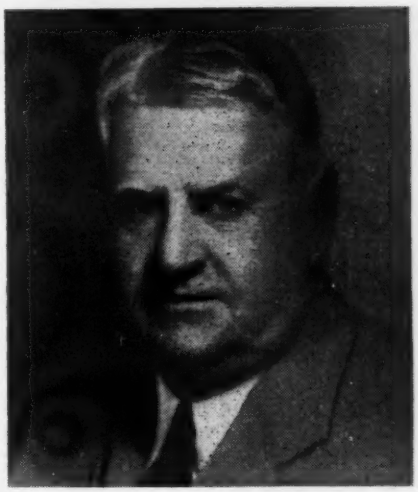
Mr. Hogan entered the accounting department of the old Marion Light & Heating Co., which later became the Indiana General Service Corp. Following service in World War I, he returned to the Marion utility and in 1923 was appointed commercial manager, a position he held until 1931 when he became assistant general manager.

A. Hogan

He was elected vice-president and general manager of Indiana General Service Co. in 1941 and this year when the company was merged with the Indiana & Michigan Electric Co., Mr. Hogan became vice-president of Indiana & Michigan and general manager of the Indiana General Service division, the position he now holds.

T. N. McCarter Resigns As Public Service Chairman

Thomas N. McCarter, whose resignation as chairman of the board of directors of the Public Service Corp. of New Jersey was announced last week (Electrical World, October 20, page 10), was the prime mover in the formation in 1903 of the Public Service Corp. The consolidation of various public utility companies in New Jersey into one unified system was first proposed by Mr.



T. N. McCarter

McCarter; he was instrumental in effecting it and has been in executive charge continuously from the time of its formation.

Mr. McCarter was the first president of Public Service and was reelected to the presidency of the corporation and constituent companies each succeeding year up to 1939, when he became chairman of the board of directors at his own request. At that time he gave among the reasons for the request that he be relieved from the presidency, his age and a desire to be free from the daily detail of management. Upon his assuming the chairmanship, the late Edmund W. Wakelee became president and when Mr. Wakelee died this year George H. Blake succeeded to the office.

Mr. McCarter is widely known in the utility field not only as head of one of the largest public utility enterprises in the United States, but also through his identification with national associations, in which he has been active for many years. He was the first president of the Edison Electric Institute and served two terms in that capacity. He served as president of the American Electric Railway Association for the year 1911-12 and was chairman during World War I of that organization's war board.

Mr. McCarter was born in Newark, October 20, 1867, was graduated from Princeton and later attended Columbia

University Law School. In 1891 he became a member of the law firm of McCarter, Williamson & McCarter, and later practiced alone. He early took an interest in politics and was appointed Judge of the First District Court in the City of Newark in 1896. In 1899 Mr. McCarter resigned from the bench, and in the fall of that year was elected to the State Senate. In 1902 he was appointed Attorney General of the State, resigning that position the following year to become president of Public Service Corp. of New Jersey.

•

▶ EUGENE L. BETTANIER, who started to work for the Light Department of the City of Pasadena, Calif., 36 years ago, has just been made general manager of the department to succeed BENJAMIN F. DELANTY, general manager and chief engineer, who retired after 38 years of service with the city.

•

G. C. King Appointed Sales Manager of Boston Edison

George C. King has been appointed sales manager of the Boston Edison Co. Mr. King is a native of Texas and was graduated in 1924 from the U. S. Naval Academy. After three years of service he transferred from active duty to the reserve, in order to enter private business.

In 1929 he became power sales engineer for the El Paso (Tex.) Electric

G. C. King

Co., and was later promoted to merchandising manager and general sales manager. He went to New England in 1936 as sales manager for the Brockton Edison Co., another utility affiliated with the Stone & Webster organization, and held this position, until called to active service in the Navy in 1941. He was released from active duty recently with the rank of commander.

Page Promoted by Public Service Co. of Oklahoma

Glenn I. Page, operating engineer of the Public Service Co. of Oklahoma at Lawton, has been promoted to superintendent of operations and construction for the eastern and southwestern divisions of the company. Mr. Page will make his home in Tulsa, but will continue to supervise operations of the

G. I. Page

southwestern division and spend a part of his time at Lawton.

Mr. Page brings to his new position more than 20 years experience in public utility engineering, construction and operation. He began work with Public Service in 1927 at Tulsa power station. In 1930 he was appointed operating engineer for the southwestern division with headquarters at Lawton, and had charge of operations and construction in the southwestern division. While he was in this position he directed the engineering and construction program for the extension and improvement of generating and transmission facilities serving southwestern Oklahoma.

Before joining Public Service, he assisted in the construction and installation of the power station at Des Moines, Ia., for the Iowa Power & Light Co.

Mr. Page is a member of the American Institute of Electrical Engineers.

•

▶ L. R. KING, until recently division manager of the Central Electric & Gas Co., Lincoln, Nebr., has returned to the United Light & Power Service Co. of Chicago and Davenport as consulting engineer. Mr. King's first association with the United Light system was with the Clinton, Davenport, Muscatine Railroad. Later he was rate and appraisal engineer for the United Light & Power Service Co. Just prior to taking up his duties as president of the Iowa-Nebraska Light & Power Co., Mr. King was assistant to B. J. Denman, president of United Light & Power Co.

•

R. & I. E. Appoints Carlisle Commercial Vice-President

George L. Carlisle, who was assigned to the war Production Board in 1942 to organize and act as chief of the switchgear section, has returned to the Railway and Industrial Engineering Co., Greensburg, Pa., as commercial vice-president. In his new position, Mr. Carlisle will have charge of all sales activities.

During the period he spent in Washington, his section had charge of scheduling and administering orders pertaining to switchgear, pole line hardware, insulators, synchronous condensers, frequency chargers, etc. Before he left WPB in March 1944, the transformer section had been combined with the switchgear section and he was chief of the combined section. For the past

G. L. Carlisle

year and a half he has been vice-president of T. J. Cope Inc., Philadelphia.

Before going to WPB, Mr. Carlisle had been with R. & I. E. for ten years as manager of distribution department and later as manager of sales. He had previously been with West Penn Power Co. in charge of substation design and also vice-president and general manager of the Champion Switch Co.

•

▶ S. BLAIR LENT has been appointed electrical engineer of the Boston (Mass.) Elevated Railway, succeeding J. Walter Allen, who has retired after many years in that capacity. Mr. Lent is a graduate in chemical engineering of Northeastern University and joined the company's staff in 1922 as a student ap-

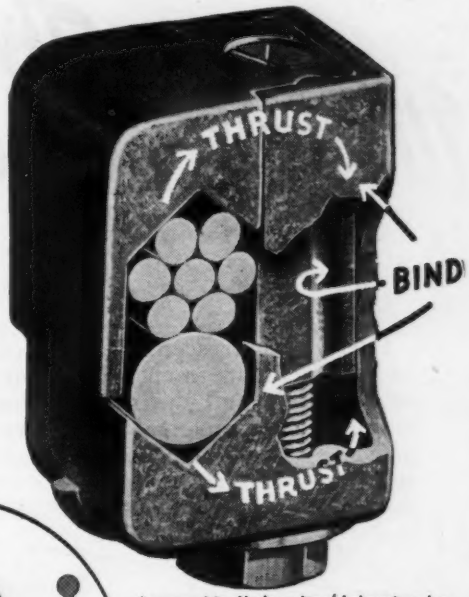
FARGO One-Piece Connectors

are *permanently* vibration-proof

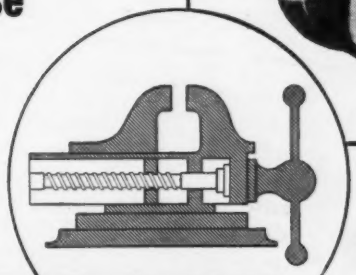
because . . .

they are *built* like a vise

. . . *grip* like a vise



Approved by Underwriters' Laboratory Inc.



High pressure at wire contact point develops tremendous *vibration-proof bind* from inside thrust against the vise-type sleeve of the body. The bolt, forged and rolled for extra strength, turns easily; develops 10 lbs. or more compression between conductors for every inch-pound of wrench pressure.

12 sizes of Fargo Solderless Connectors for wires from No. 8 solid to 1000M C.M.

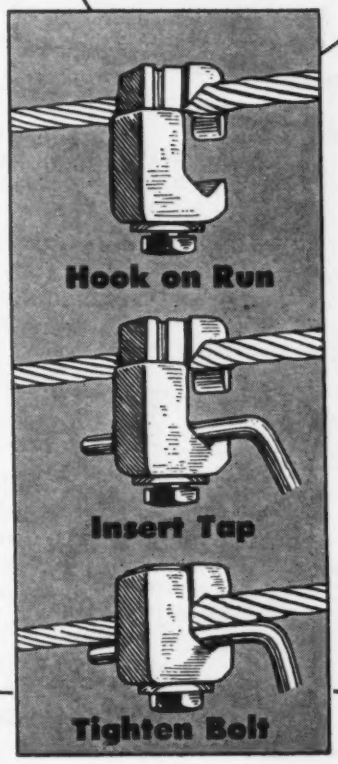
High conductivity of contact

The V-Groove jaw construction guarantees four points of contact with the Connector plus the wire-to-wire contact along a wide clamping area. The tremendously high compression, obtainable even with low turning force, can produce a slight flattening of wires at point of contact, thus improving the conductivity.

Stand up under extreme conditions

Fargo Connector bodies and bolts stand up under extreme conditions . . . *Climatic, mechanical, chemical and electrical.* Bodies are made of a tough copper-silicon-manganese alloy with a copper content of 96%. Bolts are made of a high-strength copper-tin-silicon alloy with a copper content of 98%. Each metal was adopted as best for its specific purpose, after thorough tests over a long period.

These features, which produce durability and dependability, also mean high salvage value.



EASY and SAFE to use

1. One-piece construction—always threaded—no time lost starting a nut—no chance of cross threading—no loose parts to lose.

2. Safer to use on hot lines. Bolt tightens with short, easy twist of the wrist; no arm or shoulder swing needed.

3. Any standard wrench will fit. Only two bolt head sizes (3/8" and 9/16") for 8 sizes of Fargo Connectors.

   Bolt removable—convenient in making grounds and additional taps.

Full Fargo line of Vise-type Connectors, Automatic Line Splices, Hot Line Taps and Sticks, Multiple Taps, Dead Ends, Compression Cone Connectors, Sleeves, Ground Clamps, and other Electrical Specialties are distributed by

LINE MATERIAL COMPANY · MILWAUKEE · WIS.

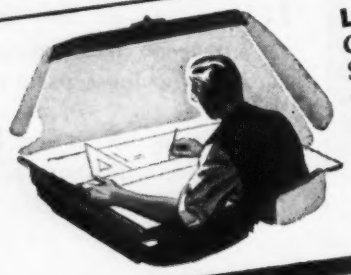
Representatives in principal cities

FARGO MFG. COMPANY ESTABLISHED 1914 POUGHKEEPSIE, N.Y.

Why these three prefer G-E

Users of fluorescent lighting, engineers and maintenance men are enjoying more efficient lighting by using G-E Watch Dog Starters. These manual reset starters are providing the utmost in all-around fluorescent lighting service in war factories all over the nation. That's why these three prefer G-E.

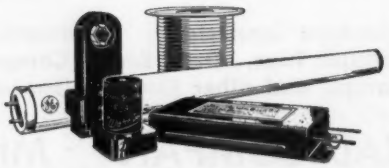
1 **Users**—are more satisfied with lighting fixtures equipped with G-E Watch Dog Starters because they banish annoying blink and flicker of dying lamps. Blinking cannot possibly recur once the Watch Dog Fluorescent Starters lock out.



2 **Lighting Engineers**—specify G-E Watch Dog Fluorescent Starters because of their unusually long life. The Watch Dog outlasts five ordinary starters. This is equivalent to approximately three years of fluorescent lighting service.

3 **Maintenance Men**—like G-E Watch Dog Starters because they reduce fluorescent lighting maintenance to the simple job of pressing a red button before relamping. Reset it . . . forget it.

Would you like to know more about G-E Watch Dog Starters? Write for our bulletin, "How to Use Fluorescent Accessories for Best Lighting Results." Send your request to Section G1052-9, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.



LAMPHOLDERS • STARTERS • BALLAST • LAMPS • WIRE

GENERAL ELECTRIC

prentice. He studied electrical engineering at Lowell Institute, Boston, and progressed through various ranks to assistant electrical engineer, from which he advanced to head the department.

•

W. A. Yost, Jr., to Direct Turbine Sales for A-C

W. A. Yost, Jr., has been appointed assistant manager of the Allis-Chalmers steam turbine department, R. C. Allen, steam department manager, announced recently. Formerly in charge of the department's marine division, Mr. Yost, among other duties, will assume direction of sales of steam turbines and the rapidly developing gas turbine.

After going to Allis-Chalmers from the Elliott Co., Jeannette, Pa., where

W. A. Yost, Jr.

he managed that company's steam turbine department, Mr. Yost immediately assumed charge of the Allis-Chalmers marine turbine division production. In this capacity, he directed the expansion of Allis-Chalmers' normally extensive marine turbine production into a vast war-time output of more than 4,000,000 hp. in geared steam turbine propulsion units for combat ships, troop and cargo carriers, repair ships, tankers, and auxiliary ships.

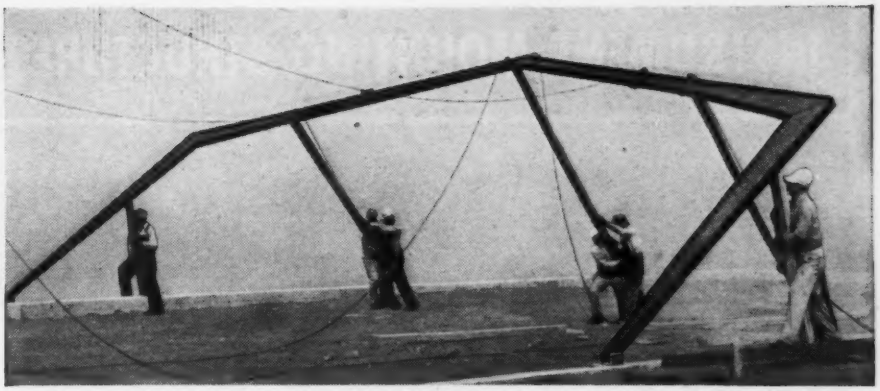
Mr. Yost joined the Elliott Co., following his graduation from North Carolina State College in 1927 with a degree in mechanical engineering.

•

▶ GEORGE H. BRAGG ended 42 years of service with the Pacific Gas & Electric Co., where for the past 33 years he has been engineer in charge of maintenance of the 52 hydroelectric powerhouses, when he retired October 1. Succeeding him is EARLE A. CRELLIN, who has been assistant to Mr. Bragg for the past nine years. Mr. Crellin previously served the P.G. & E. for 16 years as assistant

BUTLER BUILT

Rigid Frame
Trussless
STEEL BUILDING

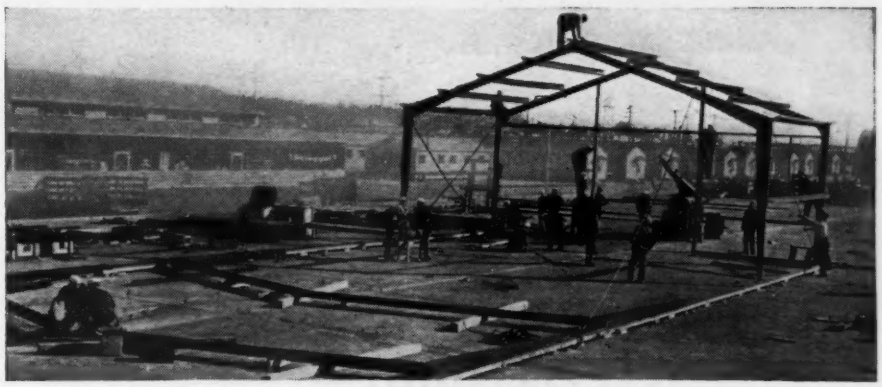


After assembly on the ground, new (trussless) rigid frame sections are readily positioned.

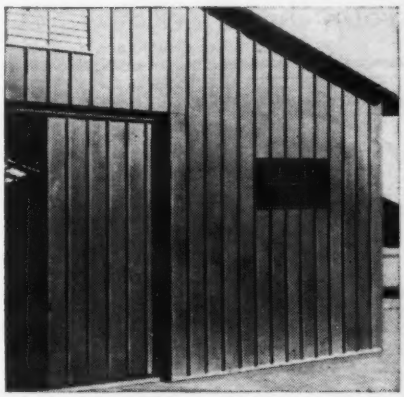
NOW AVAILABLE IN STANDARD 40′ WIDTH, OPTIONAL LENGTHS

Maximum usable space by elimination of roof trusses; simplicity of erection, savings in materials and great strength in proportion to weight have won great popularity for Butler's new rigid frame buildings. To meet this demand with reasonably prompt delivery, mass production for the present is being concentrated on a standard 40′ width and 14′ height. Length is optional in multiples of 20′ sections. Buildings are equipped with 12′ sliding door, two windows and louvre ventilator at each end. Additional side windows may be specified.

Many sizes and designs of prefabricated all-steel buildings are available in Butler conventional trussed-roof (either gable or round roof) buildings for almost any commercial or industrial use. Butler's "Steel Buildings" book is available for the asking.



Bolting of bracing and roof supporting members speedily completes assembly of frame.



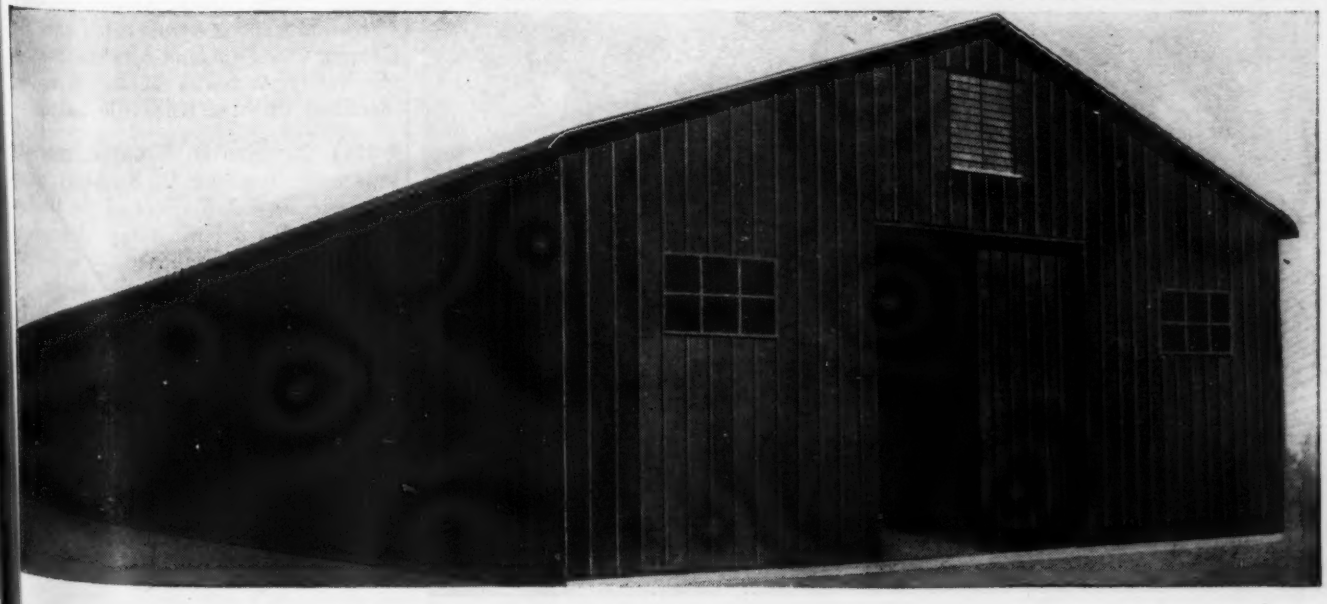
Galvanized steel sheets, strengthened with deep-drawn shouldered ribs are speedily bolted to structural frame.

Absence of roof trusses gives clear head room, making possible the use of lower sidewalls.

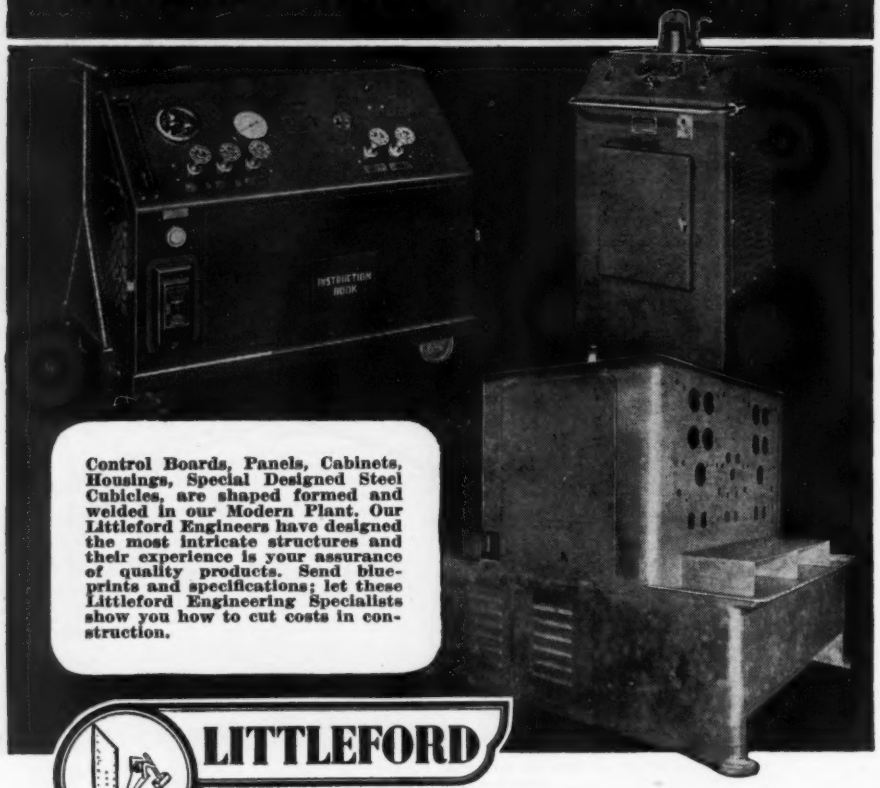
BUTLER
MANUFACTURING COMPANY

7336 East 13th St., Kansas City 3, Missouri
936 Sixth Ave. S. E., Minneapolis 14, Minn.

Factories at
Kansas City • Galesburg • Minneapolis



INSTRUMENT MOUNTING STRUCTURES



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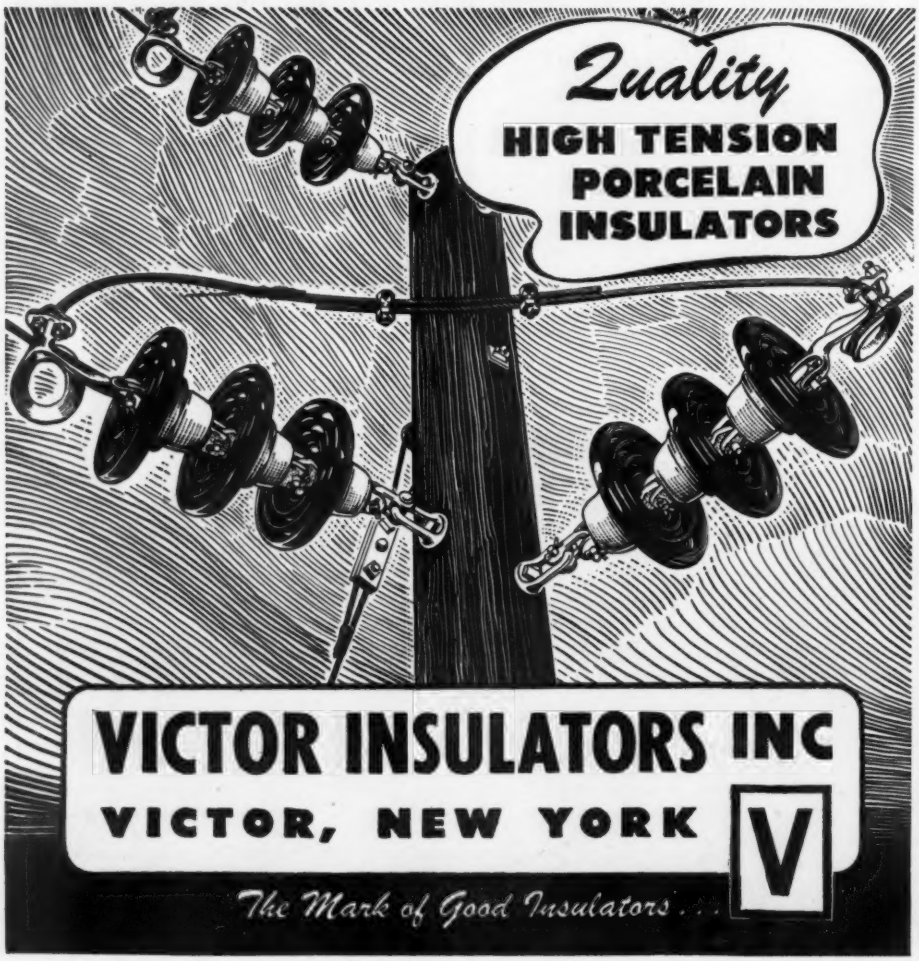

engineer in charge of hydroelectric design. Beginning his engineering career in 1902 with the Stanley Electric & Manufacturing Co. at Pittsfield, Mass., Mr. Bragg a year later joined the Valley Counties Power Co., which later merged into the P.G. & E. system. He was in charge of installations at the De Sabla powerhouse and later superintendent of the company's Electra Division. In 1912 he assumed the position he held upon retirement.

•

J. H. Turner Will Direct San Francisco Utilities

Following the recent appointment of James H. Turner to the position of director of San Francisco's utilities, Axel O. Olson has been named to succeed him as general manager and chief engineer of the Hetch Hetchy water and power system. Mr. Turner succeeds Edward G. Cahill, who resigned to enter private business and will assume his new duties about November 15. Included under his jurisdiction will be the water and power system, municipal railway and airport.

Mr. Olson has been in city service since 1926, when he was employed as an assistant electrical engineer. He was in charge of street and building lighting from 1936 to 1942, when he was appointed general manager and chief engineer of the light, heat and power bureau.

Prior to joining the city staff in 1922, Mr. Turner was employed by the Pacific Gas & Electric Co.

•

► C. O. Carpenter, Jr., has returned to the Knoxville (Tenn.) Electric Power & Water Board in the capacity of general sales manager after serving for the past three and one-half years in the United States Army Air Corps. Mr. Carpenter had been connected with the Georgia Power Co. and with the Tennessee Valley Authority before becoming identified with the Knoxville board.

► Maj. Richard D. Wilhite, recently separated from the U. S. Army after five years as a staff officer of the Boston Ordnance District in charge of production service, has returned as assistant consulting engineer for the group of electric and gas utilities formerly managed by Charles H. Tenney & Co., now having executive offices at 89 Broad Street, Boston. Mr. Wilhite was graduated from the University of Illinois in 1927, later attending the Massachusetts Institute of Technology for graduate work and then taking up public utility matters at the Harvard Business School. After a short period with the Stone & Webster organization he joined the Ten-

ney staff in 1929. He entered active Army service in 1940. The electric companies with which he will now be concerned include utilities at Fitchburg, Mass.; Concord and Exeter, N. H.; the Rockland Light & Power Co., Nyack, N. Y.; Pike County Light & Power Co., in Pennsylvania, and Rockland Electric Co., in New Jersey. In his new position he will be responsible for assignments relative to the construction and operation of utility systems, and engineering service to their industrial customers.

Detroit Edison Makes New Operating Assignments

Samuel Fraser, assistant to the superintendent of the electrical system of the Detroit Edison Co., has retired after 34 years with the company. Born in Scotland, Mr. Fraser came to this country in 1909 and in 1911 started work with the Detroit Edison Co. as an operator. In 1930 he was appointed superintendent of substations and in 1941 assistant to superintendent of the electrical system. Mr. Fraser is succeeded by F. C. Pohl, who has been identified with the company since 1921. Since 1924 Mr. Pohl has been employed in the electrical system where, in addition to his duties as assistant to superintendent of electrical system, he now also assumes responsibility for personnel relations. C. F. Ries has been made superintendent of substations. G. C. Parker has been named assistant superintendent in charge of operation, and J. W. Bleakley assistant in charge of maintenance.

L. W. Clark, formerly of the planning division, has been appointed assistant superintendent of underground lines department, reporting to H. G. Hall, superintendent. Mr. Clark's former duties in system engineering will be taken up by R. C. Bouse, who becomes utilization equipment and primary supply engineer under Harold Cole, chief planning engineer.

•

▸Edward B. Curdts, for the past 16 years superintendent of sub-station maintenance for the Narragansett Electric Co., Providence, R. I., and several other companies of the New England Power System, has joined the James G. Biddle Co., Philadelphia as applications engineer. He will travel among power companies, railways and large industrial plants to discuss problems of electrical maintenance, with particular reference to testing equipment service, and will also be available for private conferences and for addressing groups of engineers. Mr. Curdts is a past-chairman of the Providence sec-

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Assuring an adequate and uninterrupted supply of direct current (for control bus, circuit breaker and emergency loads) . . automatically and without manual attention . . . DEMANDS the "teaming together" of only the most dependable Batteries and Full-Automatic Chargers. That the "Diverter-Pole" Charger ranks at the top of the list is supported by thousands of installations made in the past 30 years . . . PROOF that the "Diverter-Pole":
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★ SHARES LOADS WITH BATTERY . . . Its "constant-voltage" characteristic permits the "Diverter-Pole" Charger to carry all loads within its safe capacity. The change to a "constant-current" characteristic (Zone 2) shifts automatically dangerous overloads to the "team-mate" battery operating in Zone 3 . . . thereby protecting itself against harmful overloads.
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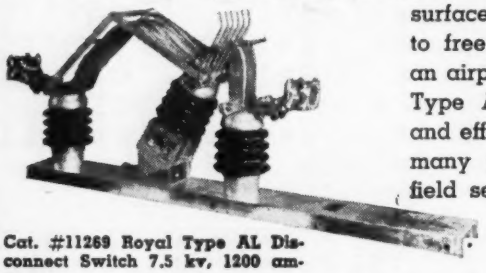

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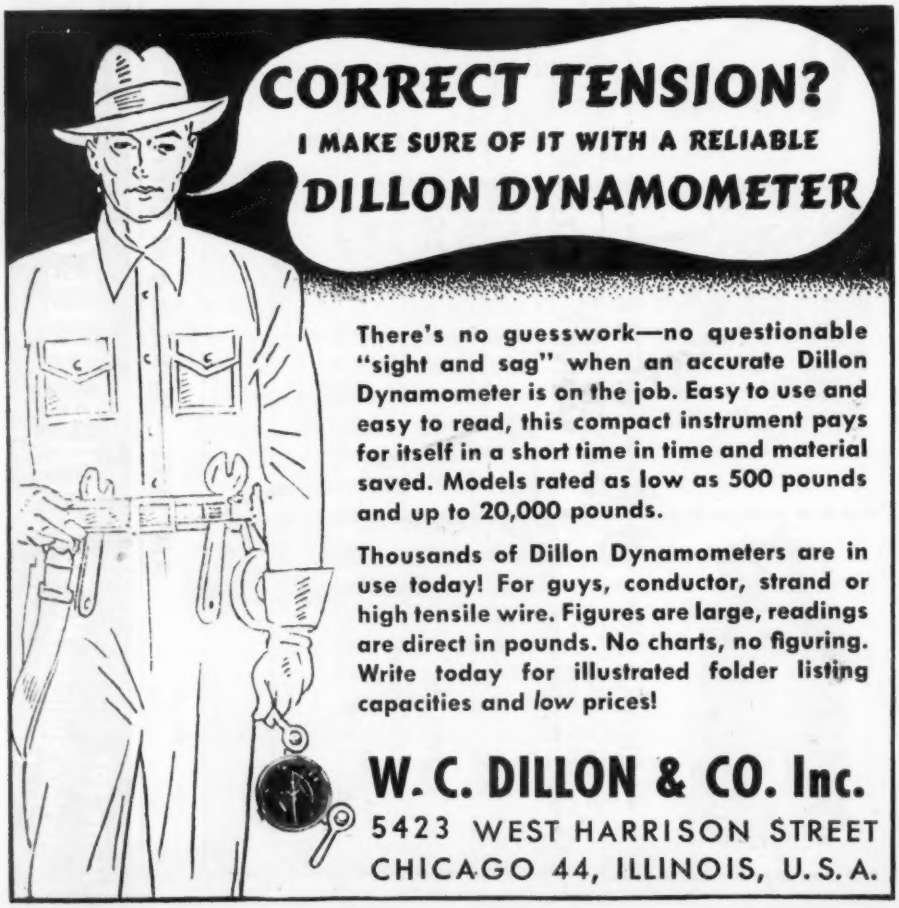

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tion of the A.I.E.E., and of the Electrical Apparatus Committee of New England, a group of utility engineers. Before going to New England he was superintendent of the southern division of the Virginia Electric & Power Co., and previously was a member of the engineering and construction department of the predecessor Virginia Railway & Power Co.

▶ RAYMOND K. MCCLINTOCK, engineer with Sylvania Electric Products, Inc., since 1936, has been appointed engineering consultant for the company's international division with headquarters in New York. He will represent the radio and lighting divisions and work directly with sales managers in Mexico and South America, as well as those in Europe and Asia when normal trade is resumed.

▶ CLARK M. OSTERHELD has been appointed general manager of the Clark Water Heater Division of McGraw Electric Co. of Chicago, succeeding the late A. E. Julian. Mr. Osterheld designed and built one of the first storage type electric water heaters and holds over fifty patents on improvements. He at one time manufactured the Clark heater, which bears his name, in Stoughton, Wis. He sold his interest in the Stoughton Mfg. Co. to McGraw Electric Co. in 1928 and subsequently joined the company in 1938 as chief engineer in charge of research and development. Since that time he has been closely associated with Mr. Julian in an advisory capacity.

▶ HENRY G. CLUM has been appointed sales manager for the Art Metal Co., Cleveland. Associated with the Jersey Central Power & Light Co. for 16 years, Mr. Clum began as a lighting specialist at Morristown, N. J., and was promoted to manager of the lighting department in charge of design and promotion of all phases of lighting application. Since 1942 Mr. Clum has acted continuously as president of the New Jersey Council of Electrical Leagues and is active in the Illuminating Engineering Society and in the Better Light-Better Sight Bureau. He is the author of numerous articles on lighting techniques which have appeared in electrical publications.

▶ HERBERT METZ will take over the duties of assistant eastern district manager for the Graybar Electric Co. on November 1 in eastern district headquarters at 180 Varick St., New York City. He has served since 1939 as general lamp and lighting sales manager in the company's executive offices in the Graybar Building. Mr. Metz became associated with the Western Electric Co. in Chicago in 1914. Subsequent assignments brought him to the East and in 1923 when the Western Electric

Supply Department was set up as a separate entity, he was made advertising manager. When Graybar was organized in 1926 he became advertising manager and a few years later was made sales promotion manager. He served as a director in the Association of National Advertisers. When the Adequate Wiring Bureau was launched in 1938, Mr. Metz was made chairman of the plan committee, and in 1941 was elected chairman of the executive committee. At present he is chairman of the post-war planning committee of the National Electrical Wholesalers Association.

▶L. ALAN SHARP has returned to the National Electric Products Corp., Pittsburgh, in the capacity of designing engineer. During 1928 to 1935, Mr. Sharp was instrumental in the company's development of many new wiring systems. In 1935 he became associated with the U. S. Housing Authority as electrical engineer. He served on many technical committees of the Authority and other government agencies involved in the establishment of standards, procedures, and specifications. Shortly after Pearl Harbor, Mr. Sharp entered military service and was assigned to the Army Air Forces. Recently he left the Army as a Lieutenant Colonel, on an inactive status.

▶J. B. COLEMAN has been appointed as assistant director of engineering for the RCA Victor Division and M. C. BATSEL has been named chief engineer of engineering products. Mr. Coleman, who will make his headquarters at the company's home office in Camden, N. J., joined RCA in 1930. He progressed through the engineering division, holding a series of responsible positions until 1939 when he was appointed chief engineer of the engineering products department. Mr. Batsel became associated with RCA in 1929. Previous to his new assignment, he was chief engineer at the RCA Victor plant in Indianapolis, Ind.

▶DR. FRANCIS C. FRARY, director of research of Aluminum Co. of America, has been elected to receive the Perkin Medal in recognition of his outstanding accomplishments in the field of industrial reserach, Cyril S. Kimball, secretary of the American section of the Society of Chemical Industry, has announced. Presentation of the medal will be made at a dinner meeting of the society at the Hotel Commodore, New York, on the evening of January 11. In addition to being a member of the Society of Chemical Industry, Dr. Frary is a member and a past-president of the American Institute of Chemical Engineers and the Electrochemical Society. He is also a member of the

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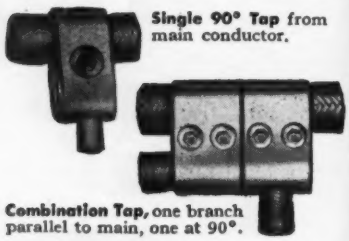

Single 90° Tap from main conductor.

Combination Tap, one branch parallel to main, one at 90°.

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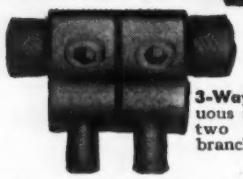

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American Chemical Society, the American Institute of Mining and Metallurgical Engineers and the Institute of Metals. In 1939 Dr. Frary received the Edward Goodrich Acheson Medal of the Electrochemical Society.

▶ LEWIS A. HARLOW, assistant advertising manager of Fairbanks, Morse & Co., Chicago, since 1943, has been appointed manager of the company's advertising division.

▶ THEODORE F. SMITH, president of Oliver Iron & Steel Corp., Pittsburgh, was elected chairman of the board of directors of the National Safety Council at their recent Chicago meeting.

▶ DR. WENDELL F. HESS, professor of metallurgical engineering and head of the welding laboratory at Rensselaer Polytechinc Institute, Troy, N. Y., has been elected president of the American Welding Society for 1945-46.

OBITUARY

▶ ARTHUR E. JULIAN, general manager of the Clark Water Heater Division of the McGraw Electric Co. of Chicago, died suddenly on October 2, in Binghamton, New York, at the age of 49. Mr. Julian, a pioneer in the electric water heating industry, began his association with it in 1923 when he left the Veterans Bureau to join the Stoughton Mfg. Co. as sales manager. When this company was acquired by McGraw Electric in 1928, Mr. Julian became general manager of the Clark Water Heater Division, the position he held at the time of his death. Widely known in the electrical manufacturing and utility field, Mr. Julian at one time was chairman of the committee on electric water heaters of the National Electrical Manufacturers Association.

▶ PAUL FERNEDING, who retired early this year as superintendent of the bureau of electricity, New York Board of Fire Underwriters, New York, died in White Plains, N. Y., on October 10 after a brief illness. Mr. Ferneding was born in Brooklyn, N. Y., fifty-nine years ago.

▶ ARTHUR A. BOLSTERLI, research engineer for the Moloney Electric Co., died in St. Louis, Mo., on September 25. Mr. Bosterli was born in Lucerne, Switzerland in 1892 and was graduated in 1918 from Zurich Polytechnic Institute. He had a wide engineering experience, having been associated with Oerlikin Co., in England; Brown-Boveri, Halfely Co. A.G. and Micafil in Switzerland; American Brown-Boveri, Western Electric Co., Safety Car Heating & Lighting Co., Roller-Smith Co. and more recently Moloney Electric Co. Mr.

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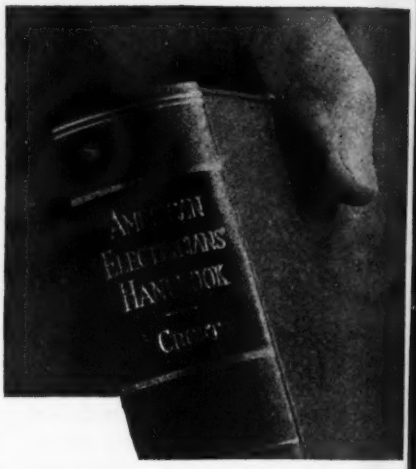

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Bolsterli was a member of the American Institute of Electrical Engineers, the Institution of Electrical Engineers and of the Schweizerischer Electrotechnischer Verein.

▶W. H. C. SMITH, General Electric wire and cable expert who retired a few years ago after nearly 40 years of service, died recently at his home in Devon, Conn. Mr. Smith's association with G.E. began in 1900 at the Schenectady Works. During ensuing years, Mr. Smith became a wire and cable specialist. In 1923, when the production of building wires and cables, portable cords, etc., was transferred to Bridgeport, he became manager of wire and cable sales. In 1936 Mr. Smith became assistant to J. H. Crawford, manager of sales for the construction materials division of General Electric. It was from this position that he retired in 1939. For many years he was active in the building wire group of the National Electrical Manufacturers Association.

▶WILLIAM R. C. CORSON, 75, chairman of the board of the Hartford Steam Boiler Inspection & Insurance Co., died in that city on October 2. He was born in New York City and after being graduated from Yale joined the Eddy Electric Mfg. Co., Windsor, Conn., as an electrical engineer, later becoming its superintendent and secretary. From 1901 to 1907 Mr. Corson maintained consulting engineering offices in Hartford. In the latter year he entered the engineering department of the insurance company, and rose to the presidency in 1927, when he was also made treasurer. He became chairman in 1942. He held many directorships in the insurance and banking fields, and was on the board of the Arrow-Hart & Hegeman Co. Numerous civic and community causes also enlisted his vigorous and able support.

▶LT. COL. JAMES A. RAMSEY, New England district manager of the General Electric Co.'s appliance and merchandise department, died recently at the Walter Reed Hospital in Washington, D. C., as a result of injuries received in London, England. At the time Colonel Ramsey was injured, he was serving with the Eighth Army Air Force. A graduate of the University of California, Colonel Ramsey joined General Electric in 1930.

▶ISIDORE DREYFUS, manager of the sales department of the Louisville Gas & Electric Co., Louisville, Ky., died in that city on October 10. Born in 1876 in Alsace-Lorraine, Mr. Dreyfus went to Louisville at the age of five and had been a resident there since that time. He became associated with Louisville Gas & Electric in 1912.

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Lag in Reconversion Laid to Government

Lewis H. Brown, president of the Johns-Manville Corp., charged that reconversion of American industry from war to peace production was "stalling" because of "short-sighted" government and labor policies on wages and prices.

Speaking to a newspaper group on a flying reconversion tour arranged by the National Association of Manufacturers, Mr. Brown urged President Truman to take the leadership in establishing a national policy with these objectives: (1) Put the reconversion job ahead of everything else; (2) Go back to the 40-hour week with present hourly rates; (3) Disallow unemployment compensation when good jobs are available so as not to encourage idleness and (4) Gradually remove ceilings of the Office of Price Administration to encourage competition in prices.

Mr. Brown predicted that this program would speed up reconversion and insure the prompt attainment of full production and employment, permitting adjustment of wages, salaries and prices into economic balance by next spring or summer.

R. W. Turnbull, president of the Edison General Electric Appliance Co., agreed that the situation was "critical," because of difficulty in getting needed labor and materials for early full production.

F. A. Hiter, senior vice-president of the Stewart-Warner Corp., emphasized the difficulty in getting component parts for early production of radios, because of the parts manufacturers' dissatisfaction with OPA ceilings.

•

Worthington Backlog Is $50,000,000; Sales Drop

Since the end of the war, cancellations and terminations of war contracts have reduced Worthington Pump & Machinery Corp.'s unfilled orders to slightly under $50,000,000. This compares with some $72,000,000 at the end of June, 1945, and $122,000,000 at the end of June, 1944. Bookings of civilian orders, however, are reported to be holding up well.

Because of cancellations and terminations at the end of the war, sales of the company for 1945 will be substantially below the $150.7 million reported for 1944. Indications are, however, on the basis of results so far, that net profit may come close to the $8.43 a share earned on the common in 1944.

•

Canada Lifts Ban on Electric Products

Restrictions on the production in Canada of electric refrigerators have been removed.

"According to reports from the industry, a few thousand units will be on the market toward the end of this year," H. H. Foreman, co-ordinator of capital equipment and durable goods, has stated. After the conversion of plants to the manufacture of refrigerators has been completed by the industry, he pointed out, production should increase rapidly, but it will take an extended period of time to stock all distributors from coast to coast. Prices for the new refrigerators will be established at 1941 basic period levels.

Radio manufacturers in Canada have also been given the green light to proceed with reconstruction plans, but they must bring their models back on the market at 1941 basic period prices. Warning to this effect was given by Mr. Foreman.

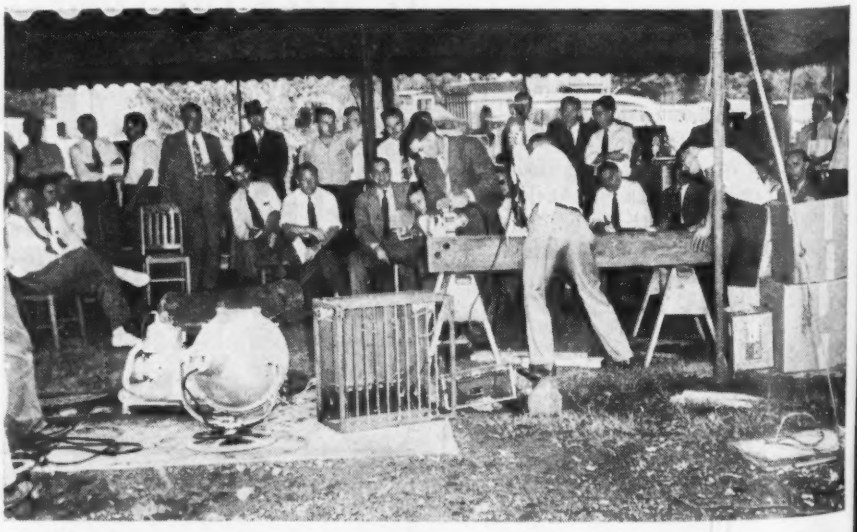
Holding prices at the 1941 basic period level is in line with previously announced policy with respect to prices of goods returning to the market. Production of new radios has been banned since 1941, but no restrictions have ever been placed on maintenance and repair parts.

•

Homelite Demonstrates 40 Units to Field Force

Design and production executives conducted a one-week engineering conference at the Homelite Corp., Port Chester, N. Y. plant to acquaint the field engineers with design changes and operating characteristics of the 40 new units now benig introduced by the company.

The meeting opened with a demonstration of each unit and this was followed by an instruction and round-table period on the unit's use, design and construction. In the demonstration, performance of pre-war models were compared with the new designs. The newer units were demonstrated with floodlights as well as several power tools, including the newest high-cycle types. New methods of ventilating also were demonstrated by the use of small gasoline-engine-driven blowers. About 50 company field engineers from all sections of the country attended the meeting to become more familiar with the units which vary in size from 500 watts to 5 kw. Also present were the Canadian representatives from the Terry Machinery Co., Montreal.



DEMONSTRATING NEW UNITS—Design and production men demonstrated 40 new units to 50 field engineers at a recent Homelite meeting in Port Chester, N. Y.

Utility Executive Urges Dealers To Progress

Howard J. Wilson, assistant merchandising manager and sales training director, Georgia Power Co., Atlanta, Ga. utility observer at the recent third Proctor Post-war Retailing Clinic for Small Appliances, cautioned the electrical appliance dealers attending that they would have to progress with the electrical industry if they expected to do a good post-war job.

In discussing employee training, he asked them to keep an open mind toward their employees' selling techniques. "Don't change a salesman's methods," Mr. Wilson said. "Give him a chance to work out his own approach to a selling problem. Oftentimes, you can learn from him yourself." He offered the services of the Georgia Power Co. to any dealer with a specific problem in electrical merchandising.

Other opinions voiced by the dealers at the clinic were that servicemen without previous experience in the electrical appliance field, unless they have made a thorough study of it, should be discouraged from investing money in the appliance business until the situation is back to normal; anyone with a legitimate store and merchandising ability should be permitted to sell convenience appliances; major appliance dealers can sell small appliances profitably if they do not "high pressure" the customer, but have a special salesperson to handle the department; hardware stores need to sell convenience appliances to compensate for the many short-discount items they must of necessity carry for their trade.

Representatives of the Proctor Electric Co. who presided at the meetings were Robert M. Oliver, vice-president; Major Oswald MacCarthy, eastern regional sales manager; A. H. Patton, Atlanta District Manager and William Lawson, Production Coordinator.

•

Elliott Company to Expand; Order Backlog, $11,000,000

In order to handle its share of anticipated post-war business, the Elliott Co., Jeannette, Pa., will probably find it necessary to acquire some of the facilities now leased from the Navy Department, Grant B. Shipley, president, stated in a recent letter to stockholders. The company's new research laboratory, now under construction, will be a valuable asset in developing and improving gas and steam turbines, condensers, generators and other equipment manufactured by the company, he said.

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The OUTSTANDING MODERN DESIGN of VIBROTEST includes a self-contained Push Button operated power supply producing a steady, constant test potential. UNDOUBTEDLY the most simple, reliable, and accurate Insulation Resistance Tester ever developed. Ranges up to 20,000 Megohms and to 1000 volts DC . Model 201 (shown). Ranges of 0-200 Megohms at applied potential of 500 volts DC., 0-2000 ohms for continuity and low resistance testing and 0-150-300-600 volts AC and DC at 1000 ohms per volt.

Model 601

A. C. VOLTAMMETER voltmeter and ammeter in one compact case.

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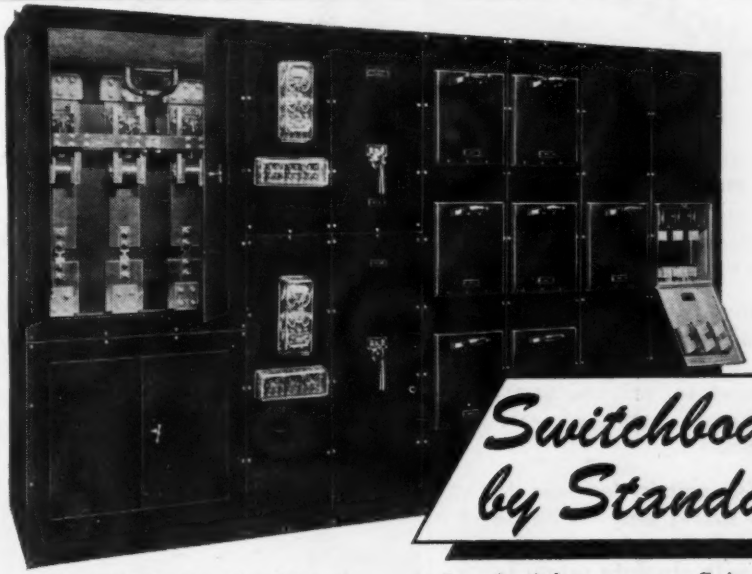

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The Eastern Specialty Company

3617 N. 8 Street, Philadelphia, Pa.

totaling about $2,000,000 have been cancelled, leaving a backlog of about $11,000,000 in government and other orders.

•

Turbine-Generator Production to Double

Production of steam turbines is expected to be double the pre-war average was the estimate made recently by Chester H. Lang, vice president and apparatus sales mangaer of General Electric Co.

The company has a backlog of over $30,000,000 in turbine-generator orders, covering both new installations and replacements of obsolete machines, Mr. Lang said. Full-scale peace-time production is expected to be reached by December in the General Electric turbine factories at Schenectady, Lynn, Mass., and Fitchburg, Mass. Many of the orders were placed before V-J day, but only recently went into production when materials were released by the War Production Board.

The backlog of turbine orders at present includes over 40 machines with a total capacity in excess of one and one-half million kilowatts, according to C. S. Coggeshall, manager of General Electric's turbine division. Some of the machines will be new models.

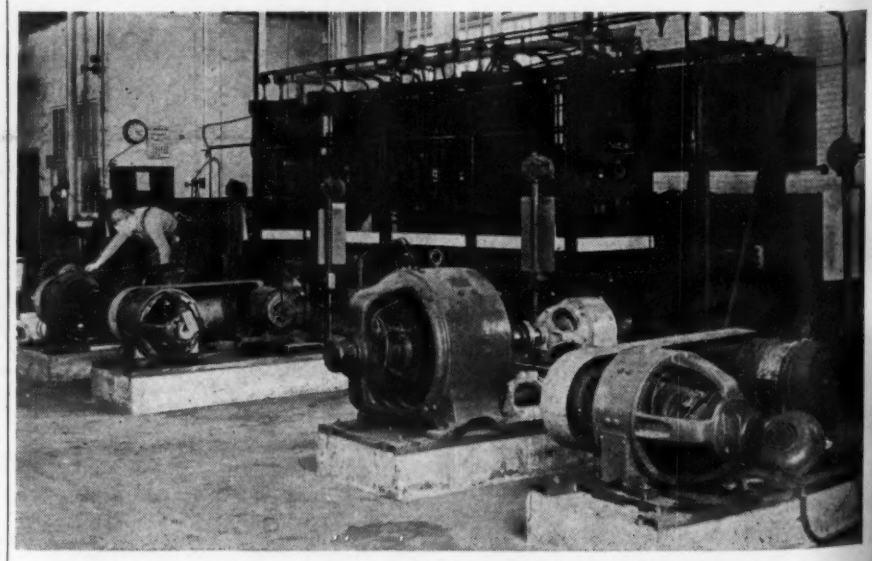
The possibilities of atomic power replacing present generating equipment, such as steam turbines, in central power stations, railroads, or other businesses in which the generation or use of power is of extreme importance, were recently discussed by Harry A. Winne, vice-president in charge of G-E engineering policies, and Dr. C. G. Suits, vice-president and director of the Research Laboratory.

"Were we responsible for conducting the affairs of such organizations," they said, "we should go right ahead with our plans for the years to come on the basis of present day commercially available sources of energy; namely coal, oil, and water power. Only as research and development proceed shall we learn the limitations and possible practical commercial applications of nuclear power."

Mr. Coggeshall also revealed that during the four war years General Electric's turbine production was nine times the average pre-war yearly production. Factories were operated at Erie, Pa., and Syracuse, N. Y., in addition to the plants at Schenectady, Lynn, and Fitchburg.

The greatest expansion was in the marine turbine manufacturing facilities. The company's production volume of marine turbines, in terms of the total horsepower capacity of the machines, was greater than the equivalent figure during 40 years of land turbine manufacture.

Comparing land turbine generating efficiency during this war with that of the first World War, Mr. Coggeshall said that six times the power was produced during World War II with only twice the amount of coal. He pointed out that this greatly increased efficiency in the use of fuel was a great boon to



TESTS EQUIVALENT TO 700 YEARS OPERATION—Silicone insulated motors especially designed to isolate the windings, on life tests now being run, are subjected to periods of operation at temperatures ranging from 200 to 310 deg. C. (392 to 590 deg. F.) alternating with periods of 100 percent humidification. Some of the motors have been in operation more than 2,000 hr., which according to the 12 deg. C. rule, is equivalent to 700 years at 160 deg. C. The accelerated-life tests are being run in the Dow Corning Corp. laboratory at Midland, Mich. in collaboration with Westinghouse Electric Corp. No failures have been experienced

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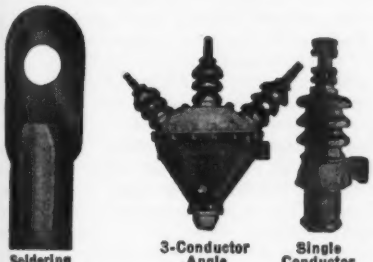

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the already overburdened rail transportation facilities over which the coal would have been hauled.

Some of the new improvements and developments which are looked forward to by G-E turbine engineers were described. First, with the development of new alloys, higher pressures and higher temperatures can be used. General Electric has recently built turbines designed to operate at 1000 degrees Fahrenheit and at pressures up to 2400 pounds per square inch.

•

Philco President Reports

Increased production capacity and present status of orders and shipments were two of the subjects treated in the report to the stockholders by John Ballantyne, president of Philco Corp. Production facilities for refrigerators has been doubled and operations in the recently authorized $1,000,000 radio plant are scheduled to start early in 1946. Storage battery orders are about as heavy as last year and new orders, output and shipments are running ahead of last year.

•

Mueller Plans Expansion

Mueller Electric Co., Cleveland, is planning a postwar plant expansion program which will add about one-third to its present manufacturing space. The first step in this program, construction of a completely new plating and finishing plant, is now under way.

POWDER AND LIGHT—Dr. H. C. Froelich, who played a leading part in developing a new "phosphor" and subsequently a new lamp, is shown in the G.E. development laboratory at Nela Park, Cleveland, with the first of the company's new super "suns" and the powder which made it possible

Photograph illustrates efficient sure grip and automatic release of Multipoint Hook.
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Field Reports on Business

Orders for electrical equipment continue to flood manufacturers of industrial apparatus, but little improvement has been noted in the delivery situation. Store modernization is being pushed with an accompanying demand for lighting and wiring supplies. Street lighting will probably advance sharply.

NEW ENGLAND

Orders for electrical equipment continue to flood manufacturers of industrial apparatus but there is little improvement as yet in deliveries, and the tight situation in raw materials which restricts output appears to be the main drawback to a sales boom. Utility power sales engineers' are assisting customers in reconversion problems, and illuminating engineers are reporting a good deal of pressure to push store modernization lighting and display advertising. Inquiries for welding units are being received by one prominent manufacturer at a steady rate and deliveries are on a three to four-month basis. Interest in machine and spot welders is gaining; there is a strong demand for electric pumping units. The outlook here is a bumper prospect in a large number of water and sewage system expansion projects in New England municipalities now hamstrung by lack of equipment. Street lighting sales should advance with the coming construction of highways; about $3,000,000 in contracts involving several important arterial routes in Massachusetts will be advertised before the first of the coming year.

Portable electric heaters are in production in two models at General Electric's Bridgeport, Conn., Works. Worcester Pressed Steel Co. reports increasing business, including orders from radio equipment and other electrical manufacturers. General Electric has leased the Farr Alpaca plant No. 2, Holyoke, Mass., with 300,000 sq. ft. of floor available for the manufacture of transformers. A scarcity of building materials is holding back the construction of a number of plants in which electrical equipment will be required. Wiring supplies are moving in small lots; sizable quantities of these will be bought in connection with hospital construction at Bedford, Mass. and Northampton under the Veteran's Administration.

Merchandising is spotty; electric hot plates, air-heaters, and portable electric lighting units are in better supply.

CHICAGO

Plans for co-op purchase and distribution of a greatly-expanded line of electric household appliances have been announced by National Cooperatives, Inc., Chicago, which serves as the central merchandising and manufacturing organization for 18 regional wholesalers, representing 5,000 retail outlets owned by 1,200,000 families in the United States and Canada. Dollar volume in 1944 totaled close to $116,000,000.

Because electrical appliances have become necessities of modern life, Co-ops—notably throughout the Midwest—have asked their local society directors to procure these items in much larger volume than ever before and to obtain many items not handled by co-ops before the war. The co-op method is to place orders in sufficient volume to induce manufacturers to produce a special "co-op" brand. These are made available to the co-op consumer at prices between 20 and 30 percent less than those asked for nationally advertised brands, according to James F. Blackburn, distribution manager of National Cooperatives' appliance staff. Orders received by National Cooperatives from regional wholesalers for many thousands of appliances have already been placed with both privately and co-operatively-owned factories.

The types of appliances to be distributed through co-op channels include electric fence controllers, fence insulators, stock prods, water systems, fans, food mixers, home freezers, hot plates, refrigerators, irons, lamp bulbs, radios, toasters, vacuum cleaners, waffle irons and washing machines. Co-op policy calls for entering the manufacturing field of a given product only when such action is necessary in order to assure a constant supply, maintain quality or reduce excessive prices.

NEW YORK

The trend of industrial production for the most part is downward, though certain industries reflect increased output.

Civil engineering construction volume in continental United States totaled $73,081,000 last week, this volume being 55 percent over the total for the preceding week and 72 percent over the corresponding 1944 week's volume, according to *Engineering News-Record*. Private construction was up 62 percent compared with the preceding week, and soared 1194 percent above the corresponding week last year as a result of the increased activity in industrial and commercial building. Public work was 33 percent higher and 2 percent lower, respectively, than the preceding week and last year. The week's construction brought 1945 volume to $1,677,272,000 for the 42-week period, an 11 percent increase over the $1,484,582,000 reported last year.

Retail trade in the Metropolitan area last week showed a substantial gain over last year.

PACIFIC COAST

Reported early rebuilding in Bay shipyards of certain larger troop transports for resumption of their pre-war Pacific service, and recent first non-priority plane passenger flights to Honolulu are significant happenings in steady transition to peacetime economy.

Scattered items of table appliances, subject to strict allocation in very small lots, are arriving on the coast, but holiday business as such is apparently out. Of major appliances, refrigerators, ranges, and washers are scheduled in that order, though November arrivals will hardly be larger than in sample quantities.

The question of prospective lower prices on heavier staples, such as rigid iron conduit and the like is being discussed as a natural result of prospective resumption of rail-water shipments between eastern factories and coast, though that date is indefinite. For nearly five years, prices on such commodities have been based on straight rail freight.

Orders include an $80,000 award for 56 miles of transmission line in Iron County, Utah; a $40,000 motor assortment of sizes 30 and 50 hp. motors, and steady though smaller orders for fractional horsepower motors, pressure pump motors, and small distribution transformers.

Sales Opportunities

KENTUCKY—Kentucky Utilities Co., Lexington, is arranging early construction of new steam-electric generating station on Kentucky River, near Tyrone. Installation will include a 25,000-kw. turbine-generator unit with accessories, coal-fired high-pressure boiler and auxiliary equipment, switchyard and miscellaneous structures. New transmission line will be built for connection with present high-tension system in Woodford County. Project is scheduled for completion early in 1947. Cost estimated about $4,200,000.

WISCONSIN—Kimberly-Clark Corp., Neenah, book, catalog and other papers, has authorized an expansion and modernization program at Quinnesec Falls Mill, Niagara, including main new one-story extension, 600 ft. long, and several other buildings, with installation of two paper-making machines, accessories and electrical equipment for large increased capacity. Entire project estimated to cost over $5,000,000, and scheduled to be completed early in 1947. R. J. Wells is manager at Niagara mill.

IOWA—Town Council, Sibley, will receive bids until November 7 for extensions and improvements in municipal steam-electric power plant, including installation of a 2,500-kw. turbine-generator unit, surface condenser of 3,750-sq. ft. rating, and auxiliary equipment. Ralph D. Thomas & Associates, Inc., 1200 2nd Ave. South, Minneapolis, Minn., is consulting engineer.

ARKANSAS—Light and Water Department, Bentonville, has plans under way for extensions and improvements in electrical distribution system, including power substations and other facilities. Cost estimated about $113,000. Marion L. Crist & Associates, Union Life Bldg., Little Rock, are consulting engineers.

TENNESSEE—Ford Motor Co., 1429 Riverside Blvd., Memphis, plans one-story addition to local assembling works for large increased capacity. Also will build new automobile parts structure. Entire project will cost about $1,000,000, with machinery and electrical equipment. Work on superstructures will be placed under way soon.

NEBRASKA—Department of Utilities, Schuyler, plans extensions in part of Colfax County for rural electric service from municipal station. State permission has been secured and work will begin at early date.

WISCONSIN—Madison Gas & Electric Co., Madison, is considering new power plant on Johnson St., to augment power supply from present Blount St. station. Details of installation and estimates of cost will be determined soon.

NEW JERSEY—Hercules Powder Co., Synthetics Division, Delaware Trust Bldg., Wilmington, Del., has plans in progress for new branch plant on part of 100-acre tract of land on Delaware River, near Burlington, consisting of several one and multi-story buildings for production of organic chemicals, resin, etc. A power substation will be built for central-station service, as well as boiler plant for factory use. Cost about $1,500,000, with machinery and electrical equipment. Work scheduled to be placed under way before close of year.

IOWA—City Council, Des Moines, has authorized extensions and improvements in street-lighting system in different parts of city, with installation of new ornamental units on different sections of S. E. First St. C. C. Green, City Hall, city lighting engineer, in charge.

PENNSYLVANIA—Continental Can Co., Inc., 100 East 42nd St., New York, plans new plant in West Mifflin Borough, vicinity of Pittsburgh. It will be used for production of general line of metal containers, steel drums, can-capping machinery, etc., consisting of a group of one-story buildings, with machinery and electrical equipment for large capacity. A power substation and boiler house are planned. Erection is scheduled to begin early next year. Cost reported in excess of $1,700,000.

WISCONSIN—City Council, Richland Center, will receive bids until November 20 for boiler and accessory equipment for installation in steam department of municipal power plant, where expansion will be carried out. Ralph D. Thomas & Associates, Inc., 1200 2nd Avenue, South, Minneapolis, Minn., is consulting engineer.

CALIFORNIA—Imperial Irrigation District, Imperial, is arranging early election to approve bond issue of $6,200,000 for expansion and improvements in plants and system, including new steam-electric generating station at El Centro, power substations in different parts of territory, transmission and distribution lines, and other facilities.

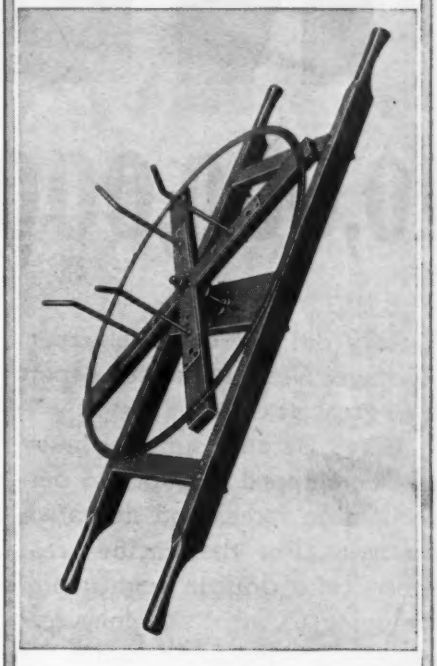
ALABAMA—Water Department, Mobile, plans installation of motor-driven pumping machinery, controls and auxiliary electrical equipment in connection with extensions in water system for new source of supply from Big Creek. Entire program will cost about $2,000,000. J. B. Converse & Co., Inc., Wilson Bldg., Mobile, is consulting engineer.

TEXAS—E. I. duPont deNemours & Co., Inc., duPont Bldg., Wilmington, Del., Grasselli Chemical Division, has approved plans for new plant on part of site of former San Jacinto shipyard, La Porte. It will comprise a main one and multi-story building for production of soil chemicals, and several auxiliary units. Machinery and electrical equipment will be installed for large capacity. A power substation is planned, with series of transformer stations. Entire project is reported to cost about $2,500,000. Work will proceed at once. Rust Engineering Co., La Porte, and Clark Bldg., Pittsburgh, Pa., is consulting engineer.

CALIFORNIA—Southern California Telephone Co., 740 South Olive St., Los Angeles, has plans nearing completion for construction of a coaxial cable system from Los Angeles to Colorado River, with installation entirely underground to avoid large temperature changes; repeater station with standby units will be installed about every 5½ miles along route. Entire program will cost about $4,000,000, with work scheduled to begin early in 1947. At Colorado River connection will be made with a similar line to be constructed by American Telephone & Telegraph Co., New York, N. Y., from Atlanta, Ga., via Tucson, Ariz.

MATTHEWS WIRE REEL

a reel at low cost



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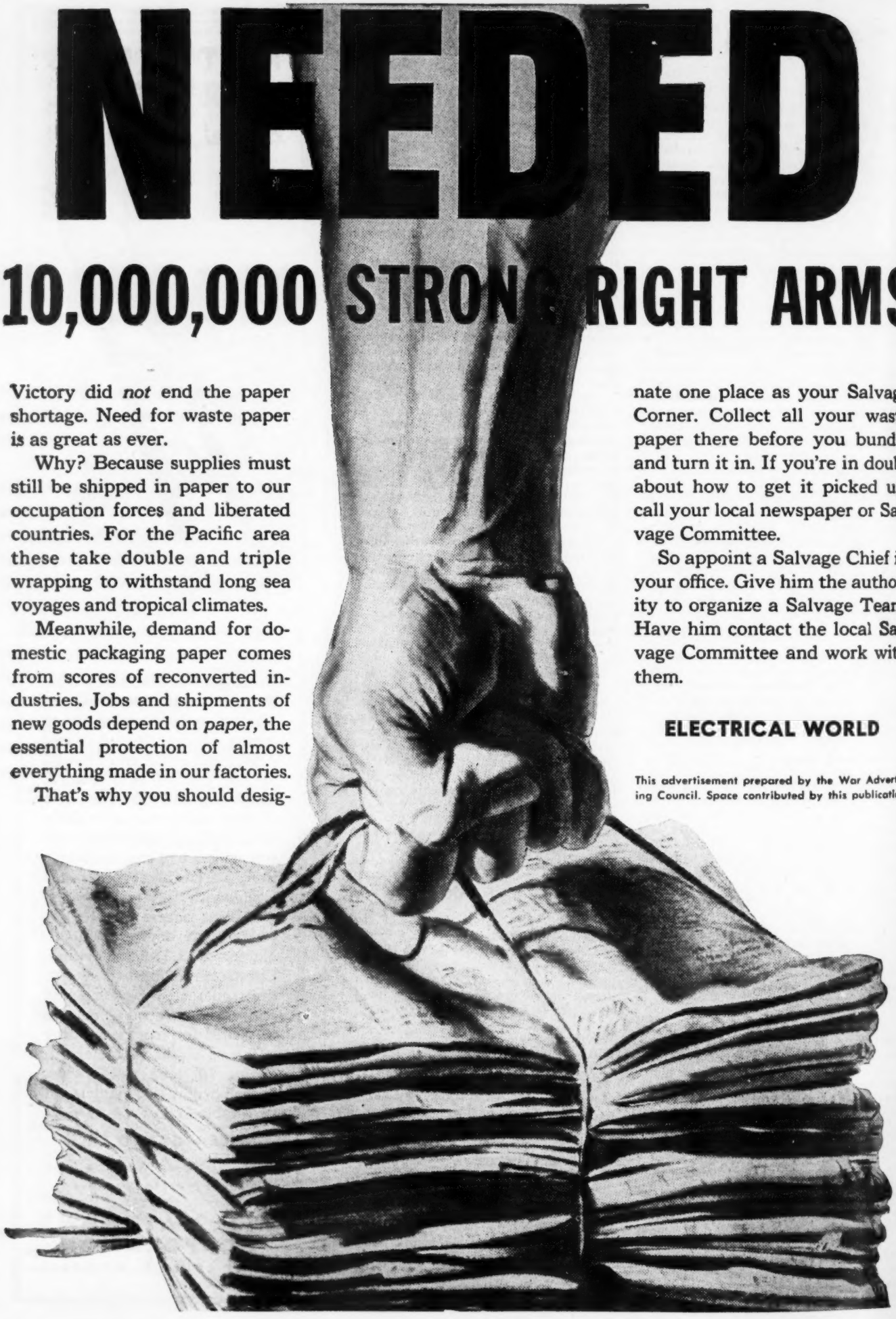

Victory did *not* end the paper shortage. Need for waste paper is as great as ever.

Why? Because supplies must still be shipped in paper to our occupation forces and liberated countries. For the Pacific area these take double and triple wrapping to withstand long sea voyages and tropical climates.

Meanwhile, demand for domestic packaging paper comes from scores of reconverted industries. Jobs and shipments of new goods depend on *paper*, the essential protection of almost everything made in our factories.

That's why you should designate one place as your Salvage Corner. Collect all your waste paper there before you bundle and turn it in. If you're in doubt about how to get it picked up, call your local newspaper or Salvage Committee.

So appoint a Salvage Chief in your office. Give him the authority to organize a Salvage Team. Have him contact the local Salvage Committee and work with them.

ELECTRICAL WORLD

This advertisement prepared by the War Advertising Council. Space contributed by this publication.

Recent Rate Changes

ALABAMA POWER CO. has filed with the state Public Service Commission lower rate schedules for urban residential and rural (combination) services following recent discussions with the commission. An estimated reduction of $678,000 in the annual revenue of the company will result from the application of the new rates, it is estimated. This reduction comes at a time when revenues are declining because of war contract cancellations," said Thomas W. Martin, president of the company, "but it is hoped that with the return to the market of the many electrical appliances, our customers will take advantage of the new and lower rates to expand the use of our service." Both of the new rate schedules provide for the installation of demand meters to determine and properly charge for the capacity requirements of larger-consumption customers in substitution for the connected load method previously followed by the company.

LAKE SUPERIOR DISTRICT POWER CO., Ashland, has been authorized by the Wisconsin Public Service Commission to revise its commercial rates for 400 customers. Under the new rates, which will go into effect November 1 charges to 130 customers will increase $3,000 a year, while 270 customers will have rates reduced $13,000 a year.

POWELL RIVER CO. is now installing meters in homes in Powell River, British Columbia, with a view to securing a more even distribution of electrical energy. On and after January 1, electric light and power will be charged on a meter consumption basis. At present, the residents pay a base rate on electrical energy. The new rate will be 1½ cents per kilowatt-hour with a 20 percent discount when the total consumption is less than 100 kw.-hr. per month. The purpose of this measure is to encourage reduced consumption, in order to make power available for suburban areas which are being built up around the pulp and paper town.

•

Arizona Asks FPC Help for Statewide Rate Study

A survey of Arizona power utility rates, third highest in the country, has been made possible by a $50,000 financing appropriation by the State Legislature which directed the Arizona Corporation Commission to borrow rate experts from the Federal Power Commission.

Early last week, Wilson T. Wright, corporation commission chairman, sent a telegraphic invitation to the FPC to participate in the survey which will include rate structure investigations of Central Arizona Light & Power Co., Tucson Gas, Electric Light & Power Co., Arizona Edison Co. and Arizona Power Corp.

The legislative appropriation came after a strong plea by Governor S. P. Osborn, who has carried on a four-year fight for the survey and who said the people of Arizona had no confidence in past surveys made by the corporation commission employing local engineers.

This announcement is not an offer to sell or a solicitation of an offer to buy these securities. The offering is made only by the Prospectus.

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